# PROCEEDINGS *of the* HAWAIIAN ENTOMOLOGICAL SOCIETY *for* 1956

VOL. XVI, No. 2
MAY, 1957

## Suggestions for Manuscripts

Manuscripts should be typewritten on one side of standard-size white bond paper, double or triple spaced, with ample margins. The sheets should not be fastened together; they should be mailed flat. Pages should be numbered consecutively. Inserts should be typed on separate pages and placed in the manuscript in the proper sequence.

Footnotes should be numbered consecutively and inserted in the manuscript immediately below the citation, separated from the text by lines. They should be used only where necessary.

All names and references should be checked for accuracy, including diacritical marks. Authors' names must be spelled out when first mentioned.

Illustrations should be planned to fit the type page, 4½ x 7 inches. They should be drawn to allow for at least one-third reduction. Each should be labeled on the back with the author's name and title of the paper, as well as the number of the figure referred to in the text. Where size or magnification is important, some indication of scale should be given. They should be numbered consecutively, using capital letters to indicate parts of a composite figure. Printed letters are available from the Secretary. Legends should be typed on a separate sheet of paper and identified by the figure number.

Tables and graphs should be used only where necessary and omitted if essentially the same information is given in the paper. Graphs and figures should be drawn in India ink on white paper, tracing cloth, or light blue cross-hatched paper.

Proofs should be corrected as soon as received and returned to the editor with the abstract on forms provided. Additional costs to the Society for correction of authors' changes in proofs may be charged to authors. An order for reprints should be placed when proofs are returned. No gratis copies of reprints are supplied.

Examination of articles in this issue will help in conforming to the style of presentation desired.

PROCEEDINGS

of the

# Hawaiian Entomological Society

VOL. XVI, NO. 2 FOR THE YEAR 1956 MAY, 1957

## JANUARY 9, 1956

The 601st meeting was held at the Experiment Station, H.S.P.A., on Monday, January 9, at 2:00 P.M., with Dr. Pemberton presiding in the absence of the President and Vice-President.

Members present: Adachi, Balock, Beardsley, Bess, Bianchi, Boyle, Carter, Ford, Fullaway, Gressitt, Hardy, Hinckley, Kajiwara, Krauss, Maehler, Nakata, Pemberton, D. Rainwater, Rosa, Steiner, Thistle, Tuthill, Van Zwaluwenburg, and Weber.

Visitor: Donald Awai.

Mr. Donald Awai was unanimously elected to membership in the Society.

Mr. Steiner, just returned from Costa Rica, gave an interesting account of a recent Mediterranean fruit fly survey of that country.

Mr. Krauss gave an account of his recent parasite explorations in Mexico, Florida, and the Antilles.

### NOTES AND EXHIBITIONS

**MEALYBUG** sp.: Mr. Beardsley exhibited specimens of what apparently is an undescribed endemic species of mealybug on tree fern (*Cibotium* sp.), which he collected on Mt. Tantalus, Oahu, on January 2.

**OOTETRASTICHUS MEGAMELI** Fullaway: Mr. Fullaway exhibited specimens of this eulophid reared from eggs of *Tarophagus proserpina* (Kirkaldy) collected at Kaakepa, Puna, Hawaii, on December 16, 1955, by Messrs. Chock and Davis. This is the first recovery of the parasite since it was introduced from the Philippines and liberated at Kahaluu, Oahu, in 1938.

**ERIOPHYID MITES:** Mr. Fullaway exhibited leaves of *Stemmadenia*, an ornamental plant, severely galled by these mites. The leaves were collected in Honolulu this month.

EUPELMUS CUSHMANI (Crawford): Mr. Fullaway exhibited this eupelmid, bred from *Araecerus levipennis* Jordan in seeds of koa haole from Kahului, Maui, collected December 26, 1955.

PLAGIOLEPIS MACTAVISHI Wheeler: Mr. Krauss mentioned an unusual abundance of this ant in Manoa Valley, Honolulu. They feed on sweets and are a general nuisance.

LATRODECTUS GEOMETRICUS Koch: Mr. Krauss stated that two specimens of this poisonous spider were collected on Eniwetok Atoll, Marshall Islands, during December, 1955, by Dr. T. J. Albert.

FRUIT FLIES: Mr. Krauss spoke of rearing *Ceratitis capitata* (Wiedemann) from *Ludia sessiliflora* Lamarck and *Harrisonia abyssinica* Oliver during July and September, 1951, respectively, at Diani Beach, Kenya. The first of these fruits was also infested by the Natal fruit fly, *Pterandrus rosa* Karsch, and both lots yielded *Opius perproximus* Silvestri. Identifications of the material were made by Dr. H. K. Munro of the South Africa Department of Agriculture.

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## FEBRUARY 13, 1956

The 602nd meeting was held at the Experiment Station, H.S.P.A., on Monday, February 13, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Awai, Beardsley, Bess, Bianchi, Boyle, Carter, Chilson, Chong, Christenson, Clagg, Clausen, Ford, Fullaway, Gressitt, Hinckley, Ito, Kamasaki, Keck, Look, Maeda, Nakata, Nishida, Pemberton, D. Rainwater, Rathburn, Rosa, Sakimura, M. Sherman, Smith, Steiner, Thistle, Tuthill, and Weber.

Visitor: Jules Fine.

Mr. R. H. Van Zwaluwenburg, retiring from active service with the Experiment Station, H.S.P.A., was elected to honorary membership in the Society.

Dr. Clausen gave an interesting account of recent work on the spotted alfalfa aphid (*Therioaphis maculata* (Buckton) ) in California.

Dr. Pemberton reported on the proceedings of the annual meeting of the Insect Control Committee of the Pacific Science Board, held in Honolulu on February 8.

### NOTES AND EXHIBITIONS

ITHOME CONCOLORELLA (Chambers): Mr. Fullaway announced that this name had been obtained for the so-called kiawe moth from the Division of Insect Identification and Parasite Introduction. The species is known from Mexico and the southwestern United States.

PSEUDOCOCCUS GALLICOLA Ehrhorn: Mr. Beardsley exhibited galled leaves of *Santalum* which he had collected on the north fork of Kaukonahua Stream, above Wahiawa, Oahu.

SOLENOPSIS GEMINATA RUFA (Jerdon): Dr. Carter stated that this ant has recently appeared in the Naiwa-Apana area of Molokai, where the elevation is about 500 feet and the average rainfall 15.83 inches per year. The infestation is well established in the uncultivated border of a pineapple field, and the colonies have moved infield. This is the first record of the species on Molokai.

COMPERIELLA BIFASCIATA Howard: Mr. Weber spoke of finding an unusually heavy population of this encyrtid wasp on the leaves of a coconut palm at Wailupe Circle, Honolulu, in January. The wasps were probably emerging from *Chrysomphalus ficus* Ashmead, which was present in numbers on the leaves.

HABROLEPIS ROUXI Compere: One specimen of this encyrtid (BULL. ENT. RES. 27:495, 1936) was found by Mr. Weber among the *Comperiella* mentioned above, constituting a new record for the Territory. *H. rouxi* was described from South Africa, as a parasite of *Chrysomphalus aurantii* Maskell.

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## MARCH 12, 1956

The 603rd meeting was held at the Experiment Station, H.S.P.A., on Monday, March 12, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Barker, Beardsley, Bess, Bianchi, Boyle, Carter, Chilson, Chock, Chong, Clagg, Fullaway, Holway, Joyce, Kamasaki, Keck, Krauss, Look, Maeda, Maehler, Nakata, Namba, Nishida, Pemberton, D. Rainwater, Rathburn, Rosa, M. Sherman, Steiner, Thistle, Tuthill, Van Zwaluwenburg, and Weber.

Visitors: A. N. Rao and S. Miyake.

A short film illustrating the habits of some newly introduced predaceous snails was shown by Mr. Weber.

Mr. Krauss gave an interesting account of his recent trip to Fiji and Tonga.

### NOTES AND EXHIBITIONS

CHEIRACANTHIUM DIVERSUM Koch: For Dr. Gressitt, Miss Nakata reported another case of bite by this spider, involving a woman at Mikilua, Waianae, Oahu, on February 26. The woman was bitten on the hand, which became red and swollen and hurt for about three hours.

LATRODECTUS GEOMETRICUS Koch: Mr. Krauss reported that this spider was abundant on Canton Island in March, but that he had failed to find *L. mactans* (F.), previously reported by Van Zwaluwenburg. This is a new distribution record for *L. geometricus*.

VANDUZEA SEGMENTATA (Fowler): Dr. Tanada stated that he had found soybean plants heavily infested with adults and nymphs of this mem-

bracid at Aiea, Oahu. They were attended by ants. This appears to be a new host record for the species in Hawaii.

**BRACHYCARA** sp.: Dr. Joyce reported finding a stratiomyiid fly, new to the main islands of the Hawaiian chain, at the Honolulu airport on December 6, 1955. This small dark fly appears to be the species reported by Bryan in 1926 from Laysan Island, from collections by D. T. Fullaway (B. P. BISHOP MUS. BULL. 31:67, 1926). According to Dr. M. T. James, it is a new species of *Brachycara*.

**PHENACASPIS COCKERELLI** (Cooley): Mr. Beardsley noted that *Phenacaspis sandwicensis* (Fullaway) is a synonym of *cockerelli*, according to Ferris (MICROENTOMOLOGY 20:46, 1955).

**ANAGYRUS FUSCIVENTRIS** (Girault): Mr. Beardsley noted that *A. nigricornis* Timberlake is a synonym of *A. fusciventris* (MEM. QUEENSLAND MUS. 4:144, 1915), according to Compere (BULL. ENT. RES. 34:129, 1943; UNIV. CALIF. PUB. ENT. 8:21, 1947).

**SPODOPTERA MAURITIA** (Boisduval): Mr. Bianchi reported the finding of a polyhedral virus disease killing caterpillars of *Spodoptera mauritia* on lawns at Aina Haina, Honolulu, on March 6. According to Dr. Tanada this is the first record of any such disease on *S. mauritia* anywhere in the world.

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## APRIL 9, 1956

The 604th meeting was held at the Experiment Station, H.S.P.A., on Monday, April 9, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Balock, Beardsley, Bess, Bianchi, Boyle, Chilson, Chock, Chong, Clagg, Ford, Fullaway, Hardy, Ito, Joyce, Kajiwara, Kamasaki, Keck, Look, Maeda, Mitchell, Nishida, Pemberton, Rathburn, Steiner, Tanada, Thistle, Tuthill, Van Zwaluwenburg, and Weber.

Visitors: S. Miyake, G. N. Rao, and K. Harley.

An excellent colored motion picture on biological control, lent by the University of California Citrus Experiment Station, Riverside, California, was shown, receiving many compliments.

### NOTES AND EXHIBITIONS

**CAMPSOMERIS MARGINELLA MODESTA** (Smith): Dr. Pemberton reported that this scoliid wasp has been found established in Western Samoa by R. A. Cumber, entomologist with the South Pacific Commission, during January, 1956, about 14 miles from the original point of liberation. A consignment of 160 females had been sent from Oahu by H.S.P.A. entomologists during October, 1952, for control of the rutelid beetle *Adoretus versutus* Harold, a defoliator of many plants.

NEW HYDROPHILIDAE: Mr. Ford exhibited three species of hydrophilids determined by H. B. Leech as *Oosternum* spp. One of these was first collected in Manoa Valley, Oahu, by E. M. Ehrhorn on May 14, 1928. None of them had been reported from the Territory previously.

IRIDOMYRMEX HUMILIS (Mayr): Mr. Ito reported that the Argentine ant had been found about one mile south of Lanai City during October, 1955; at Whitmore Village, Wahiawa, Oahu, during December, 1955; and above Lowrey Ave. bridge, East Manoa Road, Honolulu, quite recently.

TOXORHYNCHITES SPLENDENS (Wiedemann): For Stephen Au, Mr. Fullaway reported the finding of one specimen of this predaceous mosquito at Kalaheo, Kauai, on February 29th, 1956. This Philippine species was liberated by the Territorial Board of Health on Kauai on June 15, 1954, and has not been previously reported from that island.

VANDUZEA SEGMENTATA (Fowler): Mr. Weber reported finding this membracid breeding on branch tips of a *Hibiscus*, a new host record, in Honolulu on March 23. As usual, it was being attended by *Pheidole megacephala* (F.).

AMPULEX COMPRESSA (F.): Mr. Weber reported that in August of 1956 several shipments of this wasp had been sent for release on Aitutaki, Cook Islands, and that recent correspondence reports the observation of adults on more than one occasion.

PECTINOPHORA SCUTIGERA (Holdaway): Mr. Chilson reported this gelechiid moth had been intercepted by plant quarantine inspectors on June 26, 1952, and on August 9, 1955, in Hawaiian material going to the mainland. The species, determined by H. W. Capps of the U. S. National Museum, was described from Australia in commercial cotton plantings during 1926, but its primary hosts are *Thespesia populnea* (L.) Solander and *Hibiscus tiliaceus* L. Up to now it has been known from Australia and New Guinea only (BULL. ENT. RES. 17(1):67–83, 1926.)

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## MAY 14, 1956

The 605th meeting was held at the Experiment Station, H.S.P.A., on Monday, May 14, at 2:00 P.M., with President Tanada in the chair.

Members present: Awai, Beardsley, Bess, Bianchi, Boyle, Chock, Chong, Fullaway, Haramoto, Joyce, Kajiwara, Kamasaki, Keck, Look, Maeda, Maehler, Miyake, Nakata, Namba, Pemberton, Rosa, M. Sherman, Tanada, Thistle, Van Zwaluwenburg, and Weber.

Visitor: K. Harley.

An interesting motion picture on the signs used by honey bees in describing the locations of nectar sources to each other was shown by Dr. Bess.

## Notes and Exhibitions

**Phaenicia sericata** (Meigen): Dr. Bess reported for Dr. Hardy that maggots of this fly had been sent for identification by C. J. Davis, Hilo, Hawaii. They had been recovered from the right ear of a five-months-old boy at the Honokaa Hospital when they crawled out by themselves, after causing much irritation and bleeding.

**Steneotarsonemus pallidus** (Banks): Dr. Boyle stated that he and F. H. Haramoto had found a heavy infestation of the cyclamen mite on *Jasminum sambac* (L.) Aitken (pikake) during March in the area between Kaimuki and Kahala. Growers reported a large reduction in flower yield for last year's and the present crop. This is a new host record for the cyclamen mite.

**Typhlops braminus** (Daudin): Dr. Pemberton reported that this small burrowing snake had been found by Harold Hall in a garden at Lahaina, Maui, in March, 1956. This is the first record for this snake on the island of Maui.

**Coptotermes formosanus** Shiraki: It was reported for Noel Krauss that he had found this termite in a telephone pole at Canton Island in March, 1956. This is a new distribution record for the species.

**Pristomerus hawaiiensis** Ashmead: Mr. Fullaway reported rearing this braconid from larvae of *Ithome concolorella* (Chambers) collected on kiawe at Kihei, Maui, on May 7, 1956. This is a new host record.

**Aerenicopsis championi** Bates: It was reported for C. J. Davis that he had made the first recovery of this stem borer of lantana at Kaakepa, Puna, Hawaii, on April 24, 1956. The cerambycid was released at Puna approximately a year ago by the Territorial Board of Agriculture and Forestry. The recovery indicates a life cycle of approximately 10–11 months, with a pupal stage of 14 days.

**Apoanagyrus californicus** Compere: Mr. Beardsley reported finding a series of this encyrtid (Univ. Cal. Pubs. Ent. 8(1):15–20, 1947) in the H.S.P.A. collection. They were collected by O. H. Swezey in the vicinity of Koko Head during February and March, 1943, and constitute the first record for the species in the Territory. It has been reared from *Phenacoccus solani* Ferris in California.

**Anthribid beetle:** Mr. Beardsley reported collecting a species of Anthribidae new to the Territory in a light trap at Waipio, Oahu, on various dates since October, 1955.

**Helix aspersa** Müller: Mr. Weber reported that a specimen of the European brown snail was found on Round Top Drive on April 5 this year. Another single specimen had been found in Kaimuki in 1952. It has not been determined how the snail obtained entry to Hawaii.

**EUGLANDINA ROSEA** Férrusac: Mr. Weber reported recovery of one specimen of this predaceous snail at Hauula on April 10 of this year. The species had been liberated a quarter of a mile from the point of recovery during November and December, 1955.

**PSEUDALETIA UNIPUNCTA** (Haworth): Dr. Tanada reported a fairly severe infestation by this armyworm of about 200 acres of grassland on the Kahua Ranch, Kohala, Hawaii, early in April.

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## JUNE 12, 1956

The 606th meeting was held at the Experiment Station, H.S.P.A., on Tuesday, June 12, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Beardsley, Bess, Bianchi, Boyle, Chong, Fullaway, Haramoto, Hardy, Ito, Nakata, Namba, Pemberton, Suehiro, and Weber.

Visitors: Richard Warner and Mrs. J. L. Gressitt.

### NOTES AND EXHIBITIONS

**IRIDOMYRMEX HUMILIS** (Mayr): Mr. Ito stated that on June 10 he had found the Argentine ant well established in the western section of the Waimanalo Experimental Farm of the Hawaii Agricultural Experiment Station and in some adjoining areas.

**GASTERACANTHA CANCRIFORMIS** (L.): Dr. Hardy stated that a professor at the University of Hawaii had reported running into a web of this spider in his own garden and being bitten on the cheek, the bite causing local numbness which lasted about two hours but disappeared without further effect.

**CHEIRACANTHIUM DIVERSUM** Koch: Dr. Hardy reported another case of bite by this spider. A woman, reaching into a clothes bag, was bitten on the tip of a finger one morning. Following intense pain and some swelling during the morning, she went to her doctor early in the afternoon. He gave her an intravenous injection of calcium gluconate and put her on sedatives for the remainder of the day and that night. The pain lasted until about 10 o'clock in the evening but did not spread beyond the finger and was entirely gone by the next morning.

**HELIX ASPERSA** Müller: Mr. Weber stated that another probable specimen of the European brown snail had been reported to him recently from the vicinity of the Makiki pumping station in Honolulu. Unfortunately the specimen was not saved for a positive identification.

**AGROTIS YPSILON** (Rottemburg): Mr. Bianchi spoke of an unusual infestation by this cutworm in an eighty-eight-acre sugar cane field on

Kauai, early in May. As a rule this species has been found only in relatively small numbers among other armyworms and cutworms, but this time it was the only species represented in a population dense enough to harm young cane seriously.

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## JULY 9, 1956

The 607th meeting was held at the Experiment Station, H.S.P.A., on Monday, July 9, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Awai, Balock, Beardsley, Bess, Bianchi, Bonnet, Boyle, Chilson, Chong, Christenson, Clagg, Fullaway, Hardy, Hinckley, Kamasaki, Keck, Look, Macdougall, Nakata, Pemberton, D. Rainwater, Rosa, M. Sherman, Suehiro, Usinger, and Weber.

Visitors: Mrs. J. L. Gressitt, H. D. Kirschman, James Y. Kim, K. Harley, and R. E. Warner.

Dr. Usinger spoke upon problems related to the world distribution of *Halobates* and *Hermatobates*, which he is presently studying.

Dr. Bonnet gave an account of work he has been conducting during the last three years in Tahiti in connection with a French-American effort to eradicate filariasis there.

Mr. Christenson, recently returned from a trip to Florida, gave an account of the recent finding of the Mediterranean fruitfly in that state and of the present campaign against the pest.

Mr. Clagg spoke briefly on his recent trip to Guam, the Bonins, and other islands of the Pacific.

Mr. Keck spoke of a recent stay on the island of Eniwetok, where he was unable to find any ants, presumably because all the loose top-soil of the island had been completely scraped off by bulldozers during the war.

### NOTES AND EXHIBITIONS

Dr. Hardy presented the following notes:

PHYTOBIA MACULOSA (Malloch): Dr. Kenneth Frick has recently identified this agromyzid (ANN. ENT. SOC. AMER. 6:302, 1913) from specimens reared from *Helianthus annuus* L. on the University campus in May, 1956, by Dr. Martin Sherman. It has also been reared from asters, *Zinnia*, *Chrysanthemum*, and *Bidens* in Honolulu and has done serious damage to the first two this spring in the Koko Head area. The larvae form large blotch mines in which several larvae commonly occur. The adults are fairly large, shining black, and are characterized by a black spot on the white halteres. The species is widespread over the United States and is known from Argentina, Uruguay, and Bermuda, but this is a new record for the Territory.

MYCOPHILA FUNGICOLA Felt: Several specimens of this cecidomyiid (JOUR. N. Y. ENT. SOC. 19:33, 1911) have been taken in a light trap at Ewa, Oahu. Previously the species was known only from the type male and allotype female, reared from mushrooms at San Rafael, California, in 1897. Our specimens have been compared with the type and the determination confirmed by Dr. R. H. Foote of the U. S. National Museum.

ARTHROCNODAX WALKERIANA Felt: This cecidomyiid (JOUR. N. Y. ENT. SOC. 23:181, 1915) was reared from *Trionymus sacchari* (Cockerell) at Honolulu, Oct. 5, 1915, and July 15, 1930, by O. H. Swezey; *Pseudococcus boninsis* (Kuwana) at Honolulu, Aug. 9, 1930, by O. H. Swezey; *Pseudococcus adonidum* (L.) at Honolulu, February, 1956, by J. W. Beardsley; it was also collected at various times in light traps at Ewa and Waipio, Oahu. It was previously known only from the type series reared from coffee at Peradeniya, Ceylon, in 1914, and from what Dr. Ferris and Dr. Morrison believe might be *Pseudococcus kandyensis* Green. Hawaiian specimens have been compared with the type and the determination confirmed by Dr. Foote.

LESTREMIA CINEREA Macquart; LESTREMIA LEUCOPHAEA (Meigen): Both of these cecidomyiids are common at lights on Oahu. The first (INS. DIPT. NORD. FRANCE 1:173, 1826) is widely distributed over Europe and North America; it has been bred from mushrooms in England. The second (SYST. BESCHR. BEKANN. EUR. ZWEIFL. INSEKT. 1:288, 1818) is known from Europe, northern and western United States, and possibly New Zealand and Australia. Both are new records for Hawaii. The determinations were confirmed by Dr. A. E. Pritchard of the University of California.

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## AUGUST 13, 1956

The 608th meeting was held at the Experiment Station, H.S.P.A., on Monday, August 13, at 2:00 P.M., with President Tanada in the chair.

Members present: Beardsley, Boyle, Chilson, Chong, Gressitt, Haramoto, Hardy, Hinckley, Keck, Look, Macdougall, Maehler, Nakata, Namba, Nishida, Pemberton, D. Rainwater, H. I. Rainwater, Rosa, and Thistle.

Visitors: K. Harley and R. E. Warner.

Mr. R. E. Warner was unanimously elected to membership in the Society.

Dr. Gressitt gave a talk, illustrated with color slides, on his recent trip to New Guinea, the Bismarck Archipelago, and the Solomon Islands.

### NOTES AND EXHIBITIONS

DACUS CUCURBITAE Coquillett: Mr. Maehler stated that one gravid female of this species of fruit fly had been captured in a fermented lure trap on the campus of the University of California at Los Angeles on July 24, 1956. No others have been found since.

LEPIDOSAPHES TUBERCULATA Malenotti: Mr. Thistle reported that this diaspidid scale, hitherto unknown in the Territory, had been found infesting *Cymbidium* orchids in two nurseries at Hilo early this year. The species, also known as *L. machili* (Maskell) (ATLAS OF SCALE INSECTS OF NORTH AMERICA 4:397, 1942), was determined by Dr. Morrison of the U. S. National Museum. A program of eradication is being conducted by the Territorial Board of Agriculture and Forestry.

CALENDRA CARIOSA (Olivier): Mr. Beardsley exhibited an adult weevil of this species which was collected by Dr. Hardy on the beach near the Waialee Boys' School, Oahu, on July 8, 1956. Subsequent search of possible hosts in the area by Messrs. Beardsley and Bianchi failed to yield additional specimens. This is known from grasses, sedges, and sugar cane on the mainland (BULL. AMER. MUS. NAT. HIST. 98(2):146, 1951). This is a new record for the Territory.

BREVICORYNE BRASSICAE (L.): A heavy infestation of the cabbage aphid on English honeysuckle, *Lonicera* sp., at Makiki Heights, Honolulu, was reported by Dr. Tanada.

SYBRA ALTERNANS Wiedemann: Dr. Tanada reported rearing this cerambycid from larvae that had been found attacking the peduncles of passion fruit in Hilo, Hawaii. The damage caused some fruits to drop prematurely.

HELIOTHIS VIRESCENS (F.): Mr. Beardsley exhibited adults and larvae of this phalaenid moth which has recently become established on Oahu. Adults were first taken in the H.S.P.A. light trap at Ewa, Oahu, on April 30, 1956, and larvae have been recently damaging geranium (*Pelargonium*) flowers in Mr. Beardsley's yard in Aina Haina, Honolulu. Mr. Zimmerman determined the species, which is well known as the tobacco bud-worm (DESTRUCTIVE AND USEFUL INSECTS, 3rd edition, pp. 524–525). This is a serious pest of tobacco, cotton, and solanaceous plants, especially in the southeastern U. S., and is also recorded from *Physalis*, pigeonpea, geranium, beans, flax, and *Ageratum*. Several adults of *Chaetogaedia monticola* (Bigot) have issued from pupae collected in Aina Haina, and Mr. Beardsley has observed a *Eumenes campaniformis* (F.) stocking her nest with a caterpillar of the species.

ZETHA SIMONYI (Krauss): Dr. Gressitt read a letter from A. B. Gurney, of the U. S. National Museum, stating that cockroach specimens which had been sent to him from Hawaii under the name of *Holocompsa fulva* (Burmeister) had turned out to be *Zetha simonyi*, a species hitherto unrecorded from the Territory. Our local species apparently was misidentified. *Z. simonyi* was described in 1892 from the Canary Islands (ZOOL. ANZ. 15:165) and has since been recorded in the Azores, Madeira, Guatemala, Ecuador, and Peru. It is carried in commerce and is repeatedly intercepted in the U. S. from

those countries. It belongs to the same family (Polyphagidae) as *H. fulva* and has much the same habitus, but the wing venation of the two species is quite different.

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## SEPTEMBER 10, 1956

The 609th meeting was held at the Experiment Station, H.S.P.A., on Monday, September 10, at 2:00 P.M., with President Tanada in the chair.

Members present: Adachi, Beardsley, Bess, Bianchi, E. H. Bryan, Jr., Chilson, Chock, Chong, Hardy, Joyce, Kajiwara, Look, Macdougall, Maehler, Nakata, Namba, Pemberton, D. Rainwater, H. I. Rainwater, Rosa, M. Sherman, Suehiro, Weber, and Woolford.

Visitor: H. D. Kirschman.

Dr. Paul H. Arnaud was unanimously elected to membership in the Society.

Dr. Bess gave an interesting report on the activities of the Tenth International Congress of Entomology which he recently attended as part of the Hawaiian delegation.

### NOTES AND EXHIBITIONS

**TARDIGRADA:** Mr. Bryan called attention to a paper by Dr. Shinkishi Hatai, of Tohoku University, Sendai, Japan, in which three species of Tardigrada from the Hawaiian Islands are mentioned and illustrated. These are *Macrobiotus hufelandii* Schwartz, from Hilo and Kilauea, Hawaii; *Milnesium tardigradum* Doyere, from Hilo and Kilauea, Hawaii; and *Hypsibius canadensis* Murray, from Honolulu, Oahu, and from Akaka Falls and Hilo, Hawaii. They were all collected by Dr. Yata Haneda in bamboo-leaf ground litter during a brief visit he made to Hawaii in 1955 and constitute the first record of the Tardigrada in the Territory. Dr. Hatai's report is in Japanese, with English summary (SCIENCE REPORT YOKOSUKA CITY MUSEUM 1:1–12, 1956).

**ONTHOPHAGUS INCENSUS** Say: Dr. Pemberton stated that a number of specimens of this scarabaeid dung beetle were received by him from L. W. Bryan, who collected them in Kona, Hawaii, on September 1, 1956. Mr. Bryan reported that the beetles entered his room at night through the door and open window in swarms and that on the following morning the floor was covered with many he had killed with a flit gun. The insect was introduced into Hawaii from Mexico by Herbert Osborn in 1923 for control of the horn fly, *Siphona irritans* (L.) It was well established in Kona by 1934. When present in such quantities as reported by Mr. Bryan, the beetles disintegrate dung and inhibit the mass development of the horn fly, especially during dry weather.

**ACHATINA FULICA** Bowdich: Dr. Nishida reported damage to cantaloupes by the giant African snail at Waimanalo, Oahu, on August 15, 1956,

in a commercial field adjacent to a dense growth of *Leucaena glauca* (L.) Bentham. Immature and ripe fruits had been fed upon, as well as the bark at the base of the plants.

**APHYCUS FLAVUS** Howard: Mr. Beardsley reported that this encyrtid (PROC. U. S. NAT. MUS. 50:634–635, 1916) had been reared by him from *Coccus elongatus* (Signoret) collected on *Desmanthus virgatus* (L.) Willdenow at Molokai airport in June, 1956. Specimens were also collected sweeping *Desmanthus* at Ewa, Oahu, in October, 1956. Determination was made by P. H. Timberlake and establishes a new record for the Hawaiian Islands.

**PSEUDHOMALOPODA GUAMENSIS** Fullaway: Mr. Beardsley stated that he had reared this encyrtid (INSECTS OF GUAM 2:209–210, 1946) from the diaspidid scale *Odonaspis greenii* (Cockerell) collected on bamboo on the University of Hawaii campus, August 1, 1956. The host was determined by isolating individual parasitized scales. This is the first definite host record for this wasp, although Fullaway ("PROCEEDINGS,"[1] 15:9, 1953) reported breeding it from bamboo infested with *Asterolecanium bambusae* (Boisduval). *Odonaspis greenii* is usually hidden beneath the bracts at the nodes of the bamboo stems. The parasite emerges from the scale by cutting a hole through it and the overlying bract, leaving a tell-tale circular hole on the outside of the bract.

**SYNGAMIA HAEMORRHOIDALIS** Guenée: Miss Chong reported that this pyralid leaf-feeder had recently been collected on Mt. Tantalus, Oahu, indicating its possible establishment on the island. The species was found by Noel Krauss in Florida in 1955 and had been liberated by the Territorial Board of Agriculture and Forestry on Tantalus between April 20 and May 29, 1956.

**ANTHRAX DISTIGMA** Wiedemann: Mr. Bianchi stated that this bombyliid has spread to the Diamond Head area of the city and that he has been seeing one or two of the flies every day in his yard in that section. They are extremely difficult to catch, as they react quickly to any movement, but they are rather tame and upon occasion will settle upon one's arm or face. They spend much time investigating *Xylocopa* and other burrows in walls, trees, fence posts, etc., and this is not in keeping with the fact that they are supposed to parasitize the larvae of *Eumenes* wasps, which are housed in mud nests.

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## OCTOBER 8, 1956

The 610th meeting was held at the Experiment Station, H.S.P.A., on Monday, October 8, at 2:00 P.M., with Vice-President Christenson in the chair.

[1] Throughout this publication, "PROCEEDINGS" refers to the PROCEEDINGS OF THE HAWAIIAN ENTOMOLOGICAL SOCIETY.

Members present: Adachi, Au, Awai, Barker, Beardsley, Bess, Bianchi, Chilson, Clagg, Chock, Chong, Christenson, Ford, Gressitt, Hardy, Kajiwara, Kamasaki, Keiser, Macdougall, Maehler, Namba, Nishida, Pemberton, Rosa, Suehiro, Thistle, Tuthill, Warner, and Weber.

Visitors: James Kim, Asher Ota, Manuel Caldwell, Carl Isenberg, and John Siumo.

Mr. Ford gave an interesting illustrated talk on his recent collecting trip to New Guinea and other islands of the Pacific.

## Notes and exhibitions

**Araecerus levipennis** Jordan: Dr. Gressitt stated that this recent immigrant had been found breeding in seeds of *Acacia koa* Gray on Mt. Tantalus, Oahu, on September 30, 1956, by C. Brownell, and by E. J. Ford at other localities. Swezey (Bishop Mus. Spec. Pub. 44, 1954) mentions no *Araecerus* on koa; but Jordan ("Proceedings," 12(3):517–524, 1946) lists *fasciculatus* on koa, and Zimmerman took *varians* on koa at Kokee, Kauai, in 1937.

**Apis mellifera** L.: Dr. Gressitt called attention to a note by Dr. Tanada (Na Pua Okika o Hawaii Nei 5(1):4, 1955) stating that honeybees are frequently trapped in the blossoms of *Dendrobium* orchids. Most cases involve hybrids, particularly "Sunda Islands" and "strattokai," as well as other crosses of *stratiotes*.

**Toxorhynchites splendens** Wiedemann: Mr. Chock stated that Mr. Stephen Au had found one of these cannibal mosquitoes feeding on a ripe mango in the Lihue Nursery, Kauai, on September 18, 1956. The species was released in the Wailua River basin on June 15, 1954, and this is the second recovery on Kauai, the first having been made at Kalaheo on February 29, 1956.

**Culex quinquefasciatus** Say: Mr. Clagg stated that this mosquito had been eliminated from Kwajalein Island about two years ago by intensive control measures but had reappeared again in May of this year.

**Dacus frauenfeldi** Schiner: Mr. Clagg reported this tephritid as very common on Kwajalein during September, 1956, but not to be found on Ebeye on the same atoll.

**Anomala sulcatula** Burmeister: Mr. Clagg said he had collected six of these beetles on Midway Island during August of this year, but that by September none was to be seen.

**Insects on Raillardia** sp.: Mr. Beardsley stated that he and Mr. Van Zwaluwenburg had found four native insects in abundance on *Raillardia* sp. at the summit of Mt. Haleakala, Maui, on September 1, 1956. These

were *Nysius nigriscutellatus* Usinger, *Cyrtopeltis hawaiiensis* Kirkaldy, *Sarona* n. sp., and *Tephritis cratericola* Grimshaw. The last was reared in numbers from material brought to Honolulu and held in the laboratory.

AGONOXENA ARGAULA Meyrick: Mr. Weber reported finding a specimen of *Eupelmus cushmani* (Crawford) in a pupa of *Agonoxena* collected recently at Kailua, Oahu. This record adds lepidoptera to the host range of this eupelmid in Hawaii, which includes Coleoptera, mantid eggs, and tephritid flies. Fragments of another chalcid which could not be identified were found in another pupa from the same area. The ichneumonid *Gelis tenellus* (Say) was also bred from the same material, but it is not known whether it was a primary parasite.

Parasitism by *Brachymeria agonoxenae* Fullaway was very common on the windward side of Oahu during June and July. On one occasion, 21 adults were collected from three coconut trees in about two hours. Of a sample of 130 pupae of *Agonoxena*, 95, or 73 per cent, had been attacked by the chalcid.

According to Mr. Stephen Au, *Agonoxena argaula* was first observed on Kauai at Lawai-Kai in December, 1952. On January 5, 1953, the first *Brachymeria agonoxenae* was bred from material collected in this area, indicating that the parasite had arrived with its host. Now the parasite has spread to all coastal areas, and in some of them parasitism is estimated at 85 per cent.

BUPRESTIS AURULENTA L.: Mr. Weber reported a fairly heavy infestation of this beetle in the floors and walls of a 10-year-old house in Kaimuki, Honolulu. In the fall of 1955 the occupants captured a live specimen crawling across the floor. Since then exit holes have appeared at intervals, none having been noticed previously during cleanings. During some recent renovating, three dead specimens were dug from their burrows in the floor, where they presumably were killed by insecticides applied to the overlying rugs. Approximately 50 holes have been observed since the capture of the live specimen.

TRACHYPHLOEOSOMA ADVENA Zimmerman: Mr. Bianchi called attention to an article (THE COLEOPTERISTS' BULLETIN 10(2):27–31, 1956) in which E. C. Zimmerman describes this curculionid from material collected by Bianchi in 1954 on Mt. Tantalus, Oahu. Only two other species have been described in the genus: *T. alternatum* Marshall, from India, and *T. setosum* Wollaston, from Japan and St. Helena. A third species, from Tonkin, Indo-China, is undescribed and may be the same one now reported from Hawaii. The Hawaiian specimens were collected from litter under a koa tree by means of a Berlese funnel.

## NOVEMBER 13, 1956

The 611th meeting was held at the Experiment Station, H.S.P.A., on Tuesday, November 13, at 2:00 P.M., with Vice-President Christenson in the chair.

Members present: Adachi, Beardsley, Bess, Bianchi, Boyle, Chilson, Chong, Christenson, Clagg, Fullaway, Gressitt, Hardy, Joyce, Keck, Keiser, Nakata, Namba, Nishida, Pemberton, D. Rainwater, Rosa, Thistle, Tuthill, and Warner.

Visitors: Asher Ota and James Y. Kim.

## Notes and Exhibitions

**Ootetrastichus megameli** Fullaway: Mr. Fullaway reported that Stephen Au had reared this parasite from eggs of the taro leafhopper at Waimea, Kauai. This eulophid was introduced from the Philippines in 1938 and was known heretofore to be established only on Oahu and Hawaii, having been liberated only on Oahu.

**Anachaetopsis tortricis** (Coquillet): Dr. Hardy stated that he had received this determination from the U. S. National Museum for a larvaevorid fly which had been reared in Honolulu from the gelechiid moth *Anarsia lineatella* Zeller found in store–bought peaches, probably from California.

**New ptinid beetle:** Mrs. Rainwater reported collecting three specimens of a species of Ptinidae on the beach at the foot of Haeleele Valley, Kauai, on June 18, 1955. These had been sent for identification to Mr. Hugh Leech, California Academy of Sciences, who states the species is unknown to him and is not found in the Academy collections.

**Acheta domesticus** L.: Mr. Beardsley exhibited specimens of the common house cricket of Europe and America which had been taken in numbers in light traps at Ewa and Waipio, Oahu, during October and November of this year. This is the first record of the establishment of this species in Hawaii, although Chilson ("Proceedings," 15:269, 1954) reported one specimen collected at the Honolulu Airport in 1952 on plant material being sent from Honolulu to California.

Specimens from Waipio were determined by Dr. Ashley B. Gurney, who pointed out that the gender of *Acheta* is masculine and that therefore the trivial name is properly *domesticus*, not *domestica*, as it appears in the list of common names (Bull. Ent. Soc. America 1(4):8 and 16, 1955). Dr. Gurney states that the species has been spread widely by commerce, and that although commonly found indoors in temperate regions, it becomes established outdoors in warm climates. In cool regions it can maintain itself in rubbish dumps and other places which furnish shelter and food.

**Anomala orientalis** (Waterhouse): Mr. Bianchi reported that on November 5 Mr. Beardsley had captured two adults of this scarabaeid in field 6A Helemano of Waialua Sugar Plantation, and that the find extended the northern limit of *Anomala*'s range several miles beyond the town of Wahiawa, where it has been thought to lie for several years.

**New immigrant mites:** Dr. Boyle reported that four species of economically important mites have been discovered for the first time in Hawaii.

These are: (1) *Eotetranychus sexmaculatus* (Riley), on avocado leaves, Waipio, Oahu, August 10, 1955, F. H. Haramoto. Baker and Pritchard (A REVISION OF THE SPIDER MITE FAMILY TETRANYCHIDAE) state that this species has long been known as a serious pest of citrus in Florida and southern California, and more recently as a pest of avocado in California. (2) *Metatetranychus citri* (McGregor), on tangerine leaves, Waiakoa, Maui, July 19, 1955, F. H. Haramoto. Baker and Pritchard (*op. cit.*) state that this, the citrus red mite, occurs in most citrus growing areas of the world and attacks a number of broadleaved evergreen trees and shrubs. (3) *Tuckerella ornata* (Tucker), on mango stem, Honolulu, September, 1956, F. H. Haramoto. Baker and Pritchard (ANN. ENT. SOC. AMERICA 46:251, 1953) state that this species was originally described from orange fruits in Western Cape Province and Transvaal, Africa. They specify a number of other plant hosts, but not mango. (4) *Brevipalpus australis* (Tucker), on leaves of *Jasminum sambac* (L.) Aitken, Kaimuki, Oahu, October 25, 1956, W. W. Boyle. Pritchard and Baker (UNIV. CAL. PUB. ENT. 9(1):30, 1951) synonymize *B. confusus* Baker with *australis* and state it is a serious pest of orchids, presumably in California.

CALENDRA CARIOSA (Olivier): A second specimen of this beetle, reported at the August meeting, has been captured by Mr. Rosa in a cane field at Waipio, Oahu, indicating that the species is definitely established on the island and should soon begin to appear in local collections.

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## DECEMBER 10, 1956

The 612th meeting was held at the Experiment Station, H.S.P.A., on Monday, December 12, at 2:00 P.M., with Vice-President Christenson in the chair.

Members present: Adachi, Awai, Barker, Beardsley, Bess, Bianchi, Boyle, Carter, Chong, Christenson, Fullaway, Gressitt, Hardy, Kajiwara, Kamasaki, Keck, Keiser, Look, Maeda, Mitchell, Nakata, Nishida, Pemberton, D. Rainwater, Schmidt, Steiner, Suehiro, Tuthill, Warner, and Weber.

Visitors: John R. Einmo, M. S. Harapat, Carl Isenberg, James Y. Kim, Asher Ota, and F. Sicar.

Messrs. Carl Isenberg and Asher Ota were unanimously elected to membership in the Society.

The following officers were elected for 1957:

| | |
|---|---|
| *President* | L. D. Christenson |
| *President-elect* | L. D. Tuthill |
| *Secretary* | W. W. Boyle |
| *Treasurer* | J. W. Beardsley |
| *First Advisor* | C. E. Pemberton |
| *Second Advisor* | J. W. Balock |

Mr. Steiner, just returned from Florida, gave an excellent illustrated lecture on the current campaign of extermination against the Mediterranean fruit fly in that state.

## Notes and Exhibitions

**Meliana** sp. near *scotti* (Butler): Mr. Beardsley exhibited specimens of this phalaenid moth, a recently arrived immigrant which has apparently become established on Oahu. First taken in a light trap at Waipio, Oahu, early in September, it has recently become more plentiful there. A single specimen was found in light-trap material from Ewa, Oahu, on December 3. Dr. E. L. Todd of the U. S. National Museum furnished the determination.

**Acarina new to Hawaii:** Dr. Joyce stated that *Radfordia affinis* (Poppe) and *Myocoptes musculinus* (Koch) commonly occur on the house mouse, *Mus musculus* L., in Hawaii, along with *Myobia musculi* (Schrank). Zimmerman ("Proceedings," 16(1):18, 1956) first recorded *M. musculi* from Hawaii. The other two mites have not been recorded. Dr. Joyce has taken *R. affinis* from mice a number of times during the last four years, dating from the first record on April 16, 1952. *Myocoptes musculinus* was taken from a number of mice from April to September of 1956. It is thought that these mites have been here for some time along with their host but have not been recognized. An account of their biology and taxonomy is given by W. W. Smith (Ann. Ent. Soc. Amer. 48(3):196–202, 1955).

**Macrosiphum granarium** (Kirby): Dr. Hardy stated that numerous males of the English grain aphid (determined by Miss Louise M. Russell of the U. S. National Museum) had been collected recently resting on silversword plants, *Argyroxiphium macrocephalum* A. Gray, at Haleakala Crater, Maui, at an elevation of about 9,000 feet. The species was previously reported from Haleakala on a grass, *Deschampsia hawaiiensis* (Skottsberg) St. John, by Zimmerman (Insects of Hawaii 5:110, 1948), but the new record is of interest because no male aphids of any species have ever been recorded heretofore in the Territory.

**Achaea janata** (L.): Mr. Clagg exhibited larvae of this phalaenid moth that had defoliated poinsettia plants at Maloelap Housing in Pearl Harbor.

**Tapinoma melanocephalum** (F.): Mr. Clagg exhibited specimens of this ant collected recently at Navy Housing Area I. The species was formerly a common household pest in Honolulu, but the present collection is the first since 1949 in the Pearl Harbor area.

**Ampulex compressa** (F.): Mr. Clagg stated that this ampulicid parasite of cockroaches had been identified by Mr. Beardsley among insects recently collected on Midway Island. This is a new locality record for the species.

SPODOPTERA MAURITIA (Boisduval): Dr. Bess reported that Mr. Ota and he had uncovered new information regarding control of this phalaenid pest of lawns. The following points were emphasized: (1) DDT gave much better control than chlordane. DDT, at the rate of approximately 4 lbs. actual in 200 to 225 gallons of water per acre, was applied with a power sprayer and three different types of hose-on attachments. Both wettable powder and emulsifiable concentrate thus applied gave 100% larval mortality in all tests. On the other hand, chlordane emulsion, applied at the rate of approximately 2 lbs. actual in 200 to 225 gallons of water per acre, gave an average kill of only 60%. (2) Flooding of lawns with water to cause larvae to come to the surface was found an unsatisfactory sampling and detection technique. Placing boards or boxes on the grass overnight and checking for larvae under them the following morning proved to be a superior method. (3) It was found that heavily defoliated areas of lawns may support a heavy population of larvae for weeks and that weeds generally became a problem in them. Therefore, browned areas should be treated along with the rest of the lawn.

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Copies of the revised constitution are now available and may be obtained from the Secretary.

# An Annotated Checklist of Parasites and Predators Introduced into Guam during the Years 1950-1955[1]

GEORGE D. PETERSON, JR.[2]

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXTENSION SERVICE
EL CENTRO, CALIFORNIA

*(Presented at the meeting of January 9, 1956)*

## COLEOPTERA

### Coccinellidae

*Orcus chalybaeus* (Boisduval): from Hawaii in 1953 to control various aphids and scales; no evidence of establishment.

*Platyomus lividigaster* Mulsant: from Hawaii in 1953 to control various aphids; no evidence of establishment.

### Histeridae

*Hololepta minuta* Erichson and *H. quadridentata* F.: from Trinidad in 1953 and 1954 to control *Cosmopolites sordidus* Germar; establishment uncertain (one adult recovered in 1954).

### Lampyridae

*Lamprophorus tenebrosus* (Walker): from Ceylon in 1955 to control *Achatina fulica* Bowdich; establishment uncertain.

### Scarabaeidae

*Copris incertus prociduus* (Say): from Hawaii in 1953 to control *Siphona irritans* (L.): believed to be established.

*Onthophagus incensus* Say: from Hawaii in 1953 to control *Siphona irritans* (L.); no evidence of establishment.

## DIPTERA

### Culicidae

*Toxorhynchites brevipalpis* Theobald: from Hawaii in 1954 to control *Aedes* spp.; establishment doubtful.

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[1] Introductions were made under the auspices of the Department of Agriculture, Government of Guam.

[2] The author was staff entomologist for the Guam Department of Agriculture from April, 1951, to May, 1955.

*Toxorhynchites splendens* (Wiedemann): from Hawaii in 1954 to control *Aedes* spp.; establishment doubtful.

### Larvaevoridae

*Lydella stabulans grisescens* Robineau-Desvoidy: from the United States in 1952 and 1954 to control *Pyrausta nubilalis* (Hübner); recovered on two occasions following the 1952 releases, but there is no other evidence of establishment.

*Paradexodes epilachnae* Aldrich: from Mexico in 1950 and 1952 to control *Epilachna philippinensis* Dieke; did not become established.

## Hymenoptera

### Ampulicidae

*Ampulex compressa* (F.): from Hawaii in 1953 and 1954 to control *Periplaneta americana* (L.); not known to be established.

### Braconidae

*Chelonus annulipes* Wesmael: from New Jersey and Connecticut in 1952 and 1954 to control *Pyrausta nubilalis* (Hübner); no evidence of establishment.

*Macrocentrus gifuensis* Ashmead: from New Jersey and Connecticut in 1952 and 1954 to control *Pyrausta nubilalis* (Hübner); no evidence of establishment.

*Opius compensans* (Silvestri): from Hawaii in 1950, 1952, and 1953 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius fletcheri* Silvestri: from Hawaii in 1950, 1952, and 1953 to control *Dacus cucurbitae* (Coquillett): no evidence of establishment.

*Opius formosanus* Fullaway: from Hawaii in 1950, 1952, and 1955 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius incisi* Silvestri: from Hawaii in 1950, 1952, and 1955 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius longicaudatus* (Ashmead): from Hawaii in 1950, 1952, and 1955 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius longicaudatus novocaledonicus* Fullaway: from Hawaii in 1950, 1952, and 1955 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius persulcatus* (Silvestri): from Hawaii in 1950 and 1952 to control *Dacus dorsalis* Hendel; establishment doubtful.

*Opius watersi* Fullaway: from Hawaii in 1950 and 1952 to control *Dacus cucurbitae* (Coquillett); no evidence of establishment.

### Chalcididae

*Dirhinus giffardii* Silvestri: from Hawaii in 1950 to control *Dacus dorsalis* Hendel; no recoveries.

Encyrtidae

*Aphycus helvolus* Compere: from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); established.

*Aphycus lounsburyi* Howard: from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); established.

*Aphycus luteolus* Timberlake: from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); establishment uncertain.

*Aphycus stanleyi* (Compere): from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); establishment uncertain.

Eulophidae

*Amitus hesperidum* Silvestri: from Mexico in 1952 to control *Aleurocanthus spiniferus* (Quaintance); established and, together with *Prospaltella smithi* Silvestri, effecting commercial control.

*Coccophagus lycimnia* (Walker): from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); establishment uncertain.

*Coccophagus rusti* Compere: from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); establishment uncertain.

*Eretmocerus serius* Silvestri: from Mexico in 1952 to control *Aleurocanthus spiniferus* (Quaintance); establishment uncertain.

*Pleurotropis epilachnae* Rohwer: from the Philippines in 1954 to control *Epilachna philippinensis* Dieke; established and effecting commercial control.

*Prospaltella clypealis* Silvestri: from Mexico in 1952 to control *Aleurocanthus spiniferus* (Quaintacne); did not become established.

*Prospaltella opulenta* Silvestri: from Mexico in 1952 to control *Aleurocanthus spiniferus* (Quaintance); did not become established.

*Prospaltella smithi* Silvestri: from Mexico in 1952 to control *Aleurocanthus spiniferus* (Quaintance); established and, together with *Amitus hesperidum* Silvestri, effecting commercial control.

*Syntomosphyrum indicum* Silvestri: from Hawaii in 1950, 1952, and 1955 to control *Dacus dorsalis* Hendel; believed to be established.

Ichneumonidae

*Agathis agilis* (Cresson): from New Jersey in 1954. Six specimens, four females and two males, were reared from a large consignment of European corn borer larvae imported from New Jersey, from which large numbers of other parasites were reared; the species is not expected to become established.

*Horogenes punctorius* (Roman): from New Jersey and Connecticut in 1952 and 1954 to control *Pyrausta nubilalis* (Hübner); no recoveries.

Miscogasteridae

*Scutellista cyanea* Motschulsky: from California in 1954 to control *Saissetia hemisphaerica* (Targioni) and *Saissetia nigra* (Nietner); established.

Scoliidae

*Campsomeris marginella modesta* Smith: from Hawaii in 1950 and 1951 to control *Adoretus sinicus* Burmeister; established and effecting fair control.

MOLLUSCA

Streptaxidae

*Gonaxis kibweziensis* E. A. Smith: from Agiguan (Aguijan), Mariana Islands, in 1954 and 1955 to control *Achatina fulica* Bowdich; established.

# Recent Additions to the List of Insects which Attack Crops and Other Important Plants in Guam

GEORGE D. PETERSON, JR.[1]

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXTENSION SERVICE
EL CENTRO, CALIFORNIA

(*Presented at the meeting of January 9, 1956*)

Up-to-date information on the occurrence and importance of the insect pests affecting crops in Guam is not readily available. Many surveys and collections have been made by competent entomologists, but their findings, in general, are to be found in separate and unrelated publications (see bibliography), and much information has not yet appeared in print. This paper is an attempt to provide a reference to the economic insects collected on the island during recent years together with their plant hosts.

Those species marked with an asterisk are serious pests. Natural enemies of the pests listed, which are known to attack them in Guam, have been included. Those species which are considered to be important in the control of their hosts are marked with a dagger.

## HEMIPTERA

### Coreidae

*Acanthocoris clavipes* (F.)*
Hosts: eggplant, tomato, pepper, citrus.

*Riptortus* sp.
Hosts: beans, cowpea, pigeonpea, eggplant.

### Cicadellidae

*Empoasca* sp.*
Hosts: beans, eggplant, okra, pepper, cucurbits, tomato, taro, cowpea, pigeonpea, crucifers.

### Aphididae

*Aphis medicaginis* Koch*
Hosts: beans, peanut.

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[1] The author was staff entomologist for the Guam Department of Agriculture from April, 1951, to May, 1955.

Predators: *Harmonia arcuata* (F.)†, *Coelophora inaequalis* (F.)†, *Ischiodon scutellaris* (F.)†.

*Myzus persicae* (Sulzer)*
Hosts: eggplant, beans.
Predators: *Harmonia arcuata* (F.)†, *Coelophora inaequalis* (F.)†, *Ischiodon scutellaris* (F.)†.

*Rhopalosiphum pseudobrassicae* (Davis)*
Hosts: crucifers.
Predators: *Harmonia arcuata* (F.)†, *Coelophora inaequalis* (F.)†, *Ischiodon scutellaris* (F.)†, *Syrphus pusillus* Macquart.

Aleyrodidae

*Aleurocanthus spiniferus* (Quaintance)*
Hosts: citrus, rose, grape, flowering apple, peach, pear.
Parasites: *Amitus hesperidum* Silvestri†, *Prospaltella smithi* Silvestri†.

Coccidae

*Pulvinaria* sp.*
Hosts: eggplant, pepper, sweet potato.
Predators: *Cryptolaemus montrouzieri* Mulsant†.

*Saissetia oleae* (Bernard)
Hosts: *Erythrina* spp., hibiscus, croton, eggplant.
Parasites: *Tomocera californica* Howard.

Diaspididae

*Pinnaspis strachani* (Cooley)*
Hosts: pepper, eggplant, hibiscus, okra, poinsettia.

*Pseudaulacaspis pentagona* (Targioni)*
Hosts: cassava, pepper, eggplant.

COLEOPTERA

Coccinellidae

*Epilachna philippinensis* Dieke*
Hosts: eggplant, tomato, pepper, potato, zinnia, *Bauhinia* sp.
Parasite: *Pleurotropis epilachnae* Rohwer†.

Anobiidae

*Lasioderma serricorne* (F.)
Hosts: stored foods, grain drying in field, tobacco.

*Sitodrepa panicea* (L.)
Hosts: stored vegetable products.

Ostomidae

*Tenebroides mauritanicus* (L.)
Hosts: stored grains and grain products.

Tenebrionidae

*Tribolium castaneum* (Herbst)*
Hosts: stored grains and grain products.
*Tribolium confusum* Duval*
Hosts: stored grains and grain products.
*Tribolium ferrugineum* (F.)*
Hosts: stored grains and grain products.

Scarabaeidae

*Adoretus sinicus* Burmeister*
Hosts: banana, beans, corn, grape, eggplant, okra, taro, rose, croton, citrus, *Terminalia catappa* L., cowpea, pigeonpea, cabbage, broccoli, hibiscus.
Parasite: *Campsomeris marginella modesta* Smith†.
*Protaetia fusca* Herbst
Hosts: mango, beans, eggplant.

Chrysomelidae

*Aulacophora quadrimaculata* (F.)*
Hosts: cucurbits.
*Aulacophora similis* (Olivier)*
Hosts: cucurbits.
*Cassida circumdata* F.
Hosts: sweet potato, yam.
*Colasposoma metallicum rugiceps* Lefevre
Hosts: sweet potato, eggplant, cucurbits.
*Pagria signata* (Motschulsky)
Hosts: beans.

Mylabridae

*Callosobruchus maculatus* (F.)
Hosts: dried beans.
Parasite: *Aplastomorpha calandrae* Howard†.

Curculionidae

*Amorphoidea* sp.
Hosts: okra, hibiscus.

Anthribidae

*Araecerus simulatus* Gyllenhal*
Hosts: Koa haole (*Leucaena glauca* (L.) Bentham), dried cowpeas.

LEPIDOPTERA

Papilionidae

*Papilio polytes* L.* *P. xuthus* L.*
Host: citrus.

Hesperiidae

*Badamia exclamationis* F.
Host: *Terminalia catappa* L.

Sphingidae

*Hippotion celerio* L.
Host: taro.

Phycitidae

*Ephestia kuhniella* Zeller
Hosts: stored foods.
*Plodia interpunctella* (Hübner)*
Hosts: stored foods.

Crambidae

*Crambus malacellus* Duponchel
Hosts: grasses.

Plutellidae

*Plutella maculipennis* Curtis*
Hosts: crucifers.

Phalaenidae

*Erebus odora* L.
Host: monkey pod.
*Sitotroga cerealella* (Olivier)*
Hosts: stored grains and grain products.
Parasite: *Habrocytus cerealellae* Ashmead†.

Tineidae

*Bedellia somnulentella* (Zeller)*
Host: sweet potato.

Gracilariidae

*Prays endocarpa* Meyrick
Host: citrus.

DIPTERA

Tephritidae

*Dacus dorsalis* Hendel*
Hosts: papaya, citrus, mango, soursop, sweetsop, tomato, melons, guava, breadfruit, avocado, banana, *Terminalia catappa* L.

## Agromyzidae

*Liriomyza* sp.*
Hosts: crucifers.
*Melanagromyza phaseoli* (Coquillett)*
Hosts: beans.
*Melanagromyza* sp.
Hosts: crucifers.

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## Philip Wadsworth Weber

1918–1957

The entomological profession lost a diligent worker and the Territory a devoted public servant in the untimely death, at 38, of Philip W. Weber, Jr., which occurred suddenly on March 5th, 1957.

Phil was born on October 22, 1918, at Buffalo, New York. He was the son of a naval officer who retired from the service and settled in Hawaii when Phil was a child. He was educated at Punahou School and the University of Hawaii. On graduation from the latter institution, he was employed by the Territorial Board of Commissioners of Agriculture and Forestry and worked in Plant Inspection until the war in the Pacific began. He then went into medical work with the Office of Civilian Defense and later received a commission from the Navy as a medical entomologist. At the war's conclusion he returned to the Board of Commissioners of Agriculture and Forestry, where he was principally engaged in the field of economic entomology and made several trips to the Mainland in search of beneficial insects.

Phil was a brilliant student and developed a special interest in the aculeate Hymenoptera, building up a fine collection of the fossorial wasps during the past ten years. He was also interested in orchid cultivation and hybridization, stamp collecting, and insect photography. Since 1953 he has been Editor of these "Proceedings," and, as he was a perfectionist in any work he undertook, he succeeded in greatly improving the Society's publication.

His wife Constance, his daughters Judith Ann, aged 13, and Barbara Jean, aged 11, and his mother survive him.

# Trionymus rostellum Lobdell in Hawaii (Homoptera: Pseudococcidae)

JOHN W. BEARDSLEY

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HONOLULU, HAWAII

(*Presented at the meeting of March 12, 1956*)

The common grass-infesting species of *Trionymus* found in the Hawaiian Islands has gone for many years under the name of *T. insularis* Ehrhorn. Recently, a second species, *T. rostellum* Lobdell, was found to be widespread on Oahu. The presence of *T. rostellum* in the Territory was first discovered when it was found infesting a grass, *Zoisia* sp., in the quarantine greenhouse of the Territorial Board of Agriculture and Forestry in Honolulu during March, 1955. Specimens from this source were identified by Dr. Harold Morrison, and it was at first thought that the mealybugs might have been present on the grass when it arrived in Honolulu from Maryland. However, it now appears probable that the infestation originated here.

A study of specimens of grass-inhabiting *Trionymus* available in local collections has revealed that *T. rostellum* has been present in Hawaii for many years. Most of the slides seen had been determined by various local entomologists as *T. insularis*. The oldest specimen of *rostellum* found was one collected by O. H. Swezey on *Cynodon dactylon* (L.) Persoon, at Kaimuki, Oahu, on February 17, 1916. This had been determined by Ehrhorn as *Trionymus insularis*, n. sp.

It is impossible to tell from Ehrhorn's description of *insularis* whether he had *rostellum* or another species before him. *T. insularis* is discussed and figured by Ferris (1948). Ferris states, however, that he did not see the type material. His figure of the species is based on material from Kauai, whereas the type material was collected on Mauna Loa, Hawaii. It therefore appeared possible that Ehrhorn's type might have been the same as *rostellum*. However, Dr. Morrison, who has kindly examined Ehrhorn's type slide for me, finds that although poorly mounted, Ehrhorn's specimens appear to agree with the concept of *insularis* presented by Ferris. In addition to the type material from Hawaii, Ehrhorn mentions that the species had been collected on *Cynodon dactylon* at various localities on Oahu. Except for the specimen of *rostellum* from Kaimuki, misidentified as *insularis*, I have seen no Oahu specimens studied by him.

I have examined specimens of *Trionymus rostellum* (misidentified as *T. insularis*) collected at various places on Oahu from 1916 to 1930, by O. H.

Swezey on *Cynodon dactylon* and *Panicum torridum* Gaudichaud. In addition, I have seen specimens of this species collected at Mapulehu, Molokai, in 1931 by Swezey, and at the same locality on sugar cane in 1937 by Amy Suehiro. Recently, I have collected this mealybug at widely scattered localities on Oahu on various grasses, principally *Cynodon dactylon* and *Eleusine indica* (L.) Gaertner, and at Lahaina, Maui, on an unidentified grass. Mr. F. A. Bianchi has provided me with bunch-grass infested with this species which he collected at Pohakuloa, Hawaii, September 1, 1956, at about 6,000 feet elevation.

The predominant lowland grass-inhabiting species of *Trionymus*, on Oahu at least, appears to be *T. rostellum*. Considerable collecting on that island has failed to turn up *T. insularis*. The only examples of what seem to be the true *insularis* which I have seen are a slide-mounted specimen in the Bishop Museum collected at Keanakolu, Hawaii, October 29, 1952, by C. P. Hoyt on roots of bunchgrass, and a specimen which I collected on *Deschampsia australis* Nees at about 7,000 feet elevation, on Haleakala, Maui, September 1, 1956.

Several species of hymenopterous parasites are recorded as having been reared from *Trionymus insularis* in Hawaii. In view of the confusion which has existed with respect to that name, these records should be considered questionable. I have reared *Anagyrus swezeyi* Timberlake and *Marietta graminicola* Timberlake from *T. rostellum*. In each case the identity of the host was established by studying the mummies from which the parasites emerged. A mummy mounted on a point with a paratype of *M. graminicola*, and presumably the host from which that specimen emerged, was found to be *rostellum*, not *insularis* as labeled. I have also reared specimens of *Thysanus dactylopii* (Ashmead) and a species of *Pseudaphycus* from grass infested with *rostellum*. The *Pseudaphycus* has not been recorded previously in Hawaii, and probably is undescribed, according to Mr. P. H. Timberlake. Predators which have been found associated with infestations of this mealybug on Oahu are *Scymnus debilis* LeConte, *Scymnus* sp. near *dorcatomoides* Weise, *Diomus* sp., and *Gitona perspicax* (Knab).

With properly prepared slide-mounts *T. rostellum* can be separated easily from *insularis* by the presence in the former of a small, round circulus and dorsal tubular ducts. Both these features are lacking in *insularis*. In addition, *insularis* possesses multilocular disc pores on both dorsum and venter. These pores are restricted to the venter in *rostellum*. *T. rostellum* is figured by Ferris (1950) under the name of *T. vallis* Ferris, which he later synonymizes with *rostellum*. It has been collected in Louisiana, Mississippi, and California.

In life, females of *Trionymus rostellum* are grayish-pink in color and are usually lightly covered with powdery wax. Generally, they are found beneath the basal or sheath portion of grass leaves where these are rather closely appressed to the stems. Mature females tend to be elongate and average

about 3 mm. in length. They are oviparous and produce a loose cottony egg-sac. Winged males, presumably *T. rostellum*, have been reared from infested grass.

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# Two Species of Diaspididae New to the Hawaiian Fauna (Homoptera: Coccoidea)

G. F. Ferris

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(*Presented at the meeting of March 12, 1956*)

Mr. John W. Beardsley has sent me the following two species that are new to the Hawaiian fauna. One of them must be named as new while the other has been known previously only from Ceylon.

## Genus **Pinnaspis** Cockerell

**Pinnaspis caricis,** new species (fig. 1)

Hosts and distribution. From *Mondo japonicum* (L. f.) Farwell at Honolulu, Hawaii, August, 1955, M. Adachi. According to the Index Kewensis this genus is a synonym of *Carex*.

Habit. Occurring on the leaves of the host. Scale of the female elongate and brown. Scale of the male not known.

Morphological characters. In general almost identical with *Pinnaspis uniloba* (Kuwana) but differing in certain details. Median pygidial lobes fused into a single median lobe. Second pygidial lobes present, the median lobule long and slender, the outer lobule shorter and much broader. In addition to the marginal pygidial ducts, which are the same as in *uniloba*, submarginal ducts are present, these being arranged in three rows on the fifth to third abdominal segments, that of the fifth segment containing two ducts, that of the fourth segment five, and that of the third three. These are the only significant differences from *uniloba*.

Notes. It is conceivable that this is merely an extreme variant of *Pinnaspis uniloba*, but on the basis of present evidence it must be regarded as distinct.

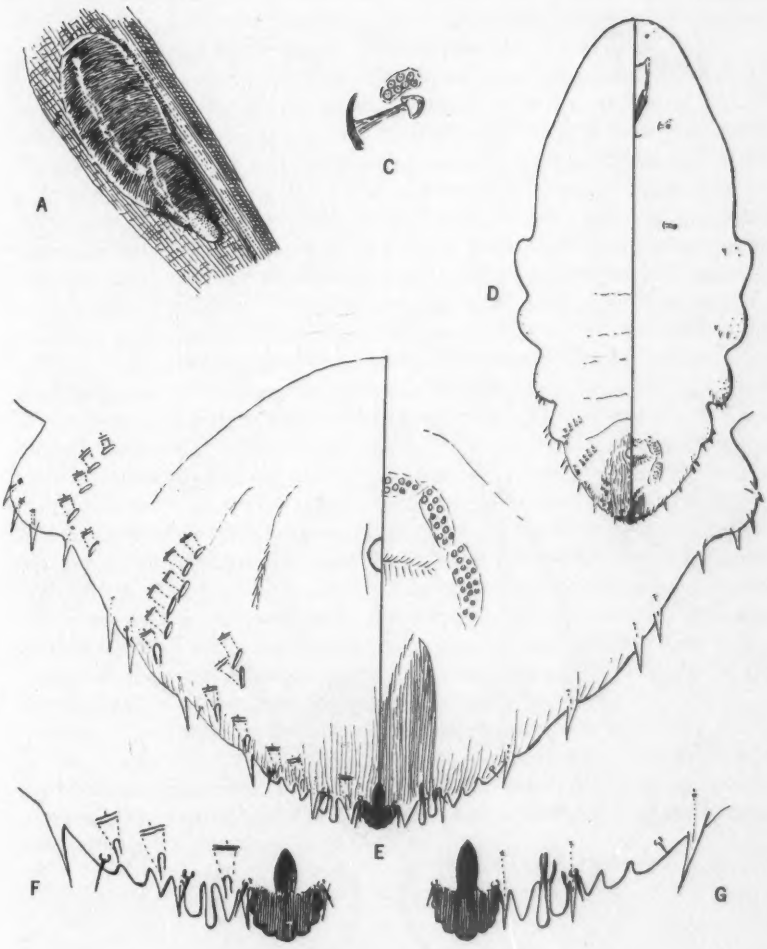
**Phenacaspis subcorticalis** (Green) (fig. 2)

*Chionaspis subcorticalis* Green, 1905, Jour. Bombay Nat. Hist. Soc. 16:351, plate K, fig. 31.

*Phenacaspis subcorticalis* (Green), MacGillivray, 1921, The Coccidae, p. 352.

*Phenacaspis subcorticalis* (Green), Ferris, 1955, Microentomology 20(3): 52, fig. 48.

Fig. 1. *Pinnaspis caricis*, n. sp. A, habit. C, anterior spiracle. D, adult female. E, pygidium of adult female. F, detail of dorsal margin of pygidium. G, detail of ventral margin of pygidium.


A
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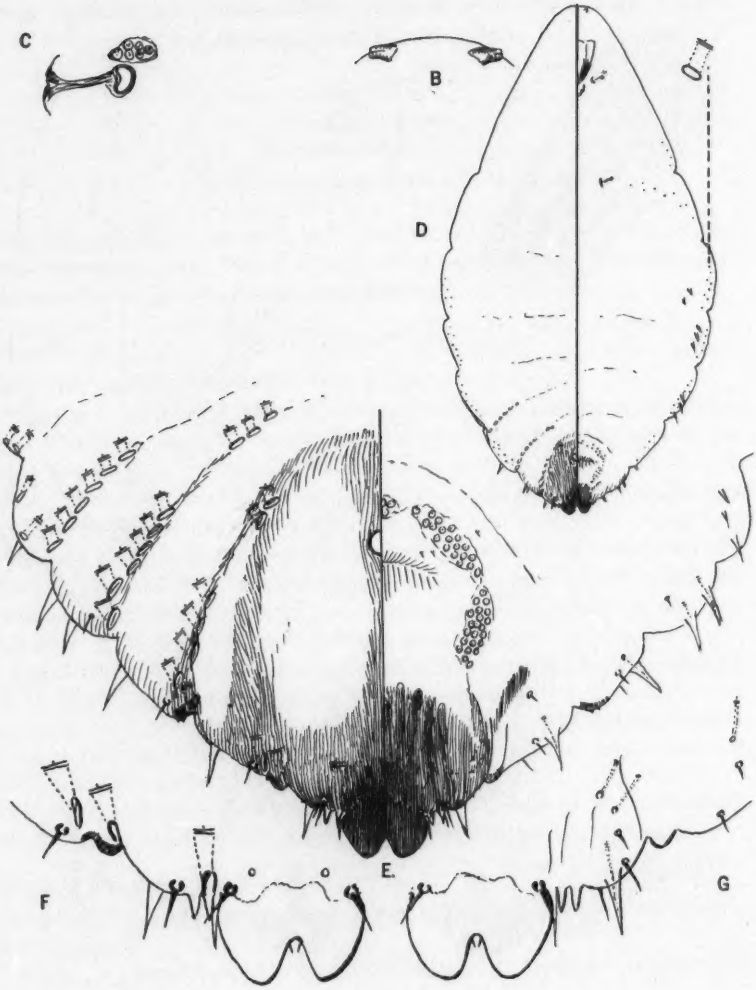
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Hosts and distribution. Originally described from *Artocarpus integrifolia* L. f. at Peradeniya and Matale, Ceylon. The Hawaiian specimens are from *Mangifera indica* L. at Ewa, Oahu, November, 1955, J. W. Beardsley.

Habit. Occurring on the bark beneath bark flakes, both in the original collection and those from Hawaii. Scale of the female white and of the elongate form common to the genus. Scale of the male not recorded.

Morphological characters. Adult female about 0.5 mm. long. Body of the form common to the genus, widest across the anterior portion of the abdomen, entirely membranous except for the pygidium. Pygidium quite acute, the median lobes large and prominent, projecting beyond the margin of the pygidium, roughly triangular, fused and strongly yoked together basally, their apices diverging and with a distinct notch between them. Second lobes extremely small, each consisting merely of a slight, acute, sclerotized point, between which and the median lobes is a slender, acute gland prominence and a small gland spine. Position of the third lobes marked by a low, apically rounded, and apically sclerotized prominence. Position of the fourth lobes (fifth segment) likewise marked by such a low prominence. Marginal macroducts arranged as follows: one between the median and second lobes; two at the base of the third lobe; and one at the position of the fourth lobe. Dorsal ducts of the pygidium arranged in three rows: row one (fifth segment) with a submarginal group of three or four and a submedian group of two pores; row two with a submarginal row of four or five and a submedian group of three; row three with a submarginal group only, this of about five pores. Margins of the third and all preceding abdominal segments with a few small macroducts. Gland spines present as one or two on each pygidial segment except the eighth, and very small gland spines present on the ventral submarginal area of the other prepygidial segments. Anterior spiracles with a very small cluster of associated pores. Antennae rather close together at the anterior margin of the head, apparently lacking apical setae.

Notes. Through the courtesy of Dr. Harold Morrison it has been possible to see a cotype specimen of this species, thus confirming the identification of the Hawaiian specimens. The figure given by Ferris in MICROENTOMOLOGY is in error in not showing the minute gland spine between the first and second lobes, which did not show in the specimen illustrated.

FIG. 2. *Phenacaspis subcorticalis* (Green). B, antennae. C, anterior spiracle. D, adult female. E, pygidium of adult female. F, detail of dorsal margin of pygidium. G, detail of ventral margin of pygidium.

# Eine neue Tenebrioniden-Art von Oahu (Coleoptera)

(13 Beitrag zur Kenntnis der Tenebrioniden)

HANS KULZER

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TUTZING, BEI MÜNCHEN, GERMANY

*(Presented at the meeting of March 12, 1956)*

Die folgende neue Art wurde von Herrn E. J. Ford, Jr., durch das Bernice P. Bishop Museum zum Studium überlassen.

**Tagalus fordi,** n. sp.

Braun bis fast schwarz, Beine und Fühler etwas heller, stark glänzend, ziemlich stark gewölbt. Länge: 3–3,4 mm., Breite 2–2,5 mm.

Kopf sehr kurz, breit, nach den Seiten gewölbt, Augen rund, flach, von den Wangen und Schläfen nicht eingeengt. Wangen sehr klein und nach vorne stark verengt, Vorderrand des Clypeus schmal, im flachen Bogen ausgeschnitten, die Ecken durch einen ± deutlichen Höcker markiert. Zwischen den Höckern ein Eindruck, der sich keilförmig bis zur Stirne fortsetzt. Die Oberfläche des Kopfes ist nicht sehr dicht aber grob punktiert. Oberlippe und Mandibeln weit vorstehend; der von oben sichbare Teil der Mandibeln ist grob punktiert. Fühler so lang wie die Stirne breit, Glied 1 dick, 2 am längsten, 3–8 sehr kurz, breiter als lang, die letzten 3 Glieder bilden eine gut abgesetzte, breite Keule, Endglied depress, gross und oval. Mentum trapezförmig, die Endglieder der Palpen langgestreckt, dünn.

Halsschild 1,5 mal so breit wie lang, nach den Seiten stark gewölbt, grösste Breite in der Mitte, die Seiten sind schwach und gleichmässig gebogen, Basis nur wenig breiter als der Vorderrand, Seitenrandkante fein, von oben überall sichtbar. Basis gerade, fein gerandet, Hinterwinkel nicht vorstehend und verrundet. Vorderrand ohne Randleiste, im leichten Bogen ausgeschnitten, Vorderwinkel schwach vorstehend und verrundet; am Vorderrand in der Mitte befindet sich ein schwacher Eindruck. Die Scheibe ist wie der Kopf punktiert und manchmal verwaschen gefleckt. Prosternum zwischen den Rippen breit, nach hinten waagrecht und etwas verrundet vorstehend, nach vorne geneigt. Die ganze Unterseite ist dicht punktiert und kahl. Beine schwach, kurz, Schienen gerade. Flügeldecken 1,5 mal so lang wie breit, parallel, Basis so breit wie die des Halsschildes und fein gerandet. Die Punktreihen sind kräftig und münden alle in die Basis. Zwischenräume gewölbt,

glatt. Seitenrandkante scharf, von oben überall sichtbar. Epipleuren wie bei den anderen Arten in der Mitte eingeengt.

Patria: 6 Exemplare aus Wahiawa, Oahu, IX, 1953, leg. E. J. Ford. Holo- und Paratypen (No. 2528) im Bernice P. Bishop Museum, Honolulu, Paratypen in der Sammlung Ford und 1 Paratype im Museum Frey. Ferner erhielt ich noch von Herrn Ford 3 Exemplare von obigem Fundort und 3 Exemplare aus Alewa Heights, Oahu, IV, 1955, leg. Ford, für das Museum Frey.

*T. fordi* ist dem *T. sumatranus* Gebien (Type im Museum Frey) sehr ähnlich, von der gleichen Form, Punktierung, Bildung der Mandibeln, Eindruck am Vorderrand des Halsschildes, und Wölbung der Zwischenräume der Flügeldecken, aber *sumatranus* ist grösser, Länge 5 mm., und hat eine 2-gliedrige Fühlerkeule.

Ich habe Abstand genommen auf Grund der 3-gliedrigen Fühlerkeule eine neue Gattung aufzustellen, da sonst alle charakteristischen Merkmale der Gattung *Tagalus* vorhanden sind. Die Gattung *Phthora*, deren Arten eine 3-gliedrige Fühlerkeule haben, hat eine andere Körperform und ein breit abgesetztes Halsschild.

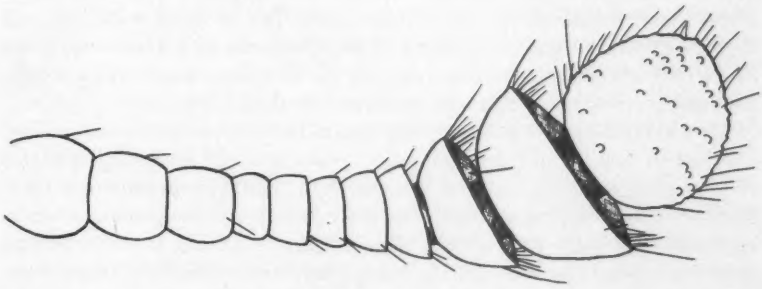

ABB. 1. *Tagalus fordi*, n. sp. Fühler.

# The Genus Pedronia Green in Hawaii, with Descriptions of New Species (Homoptera: Pseudococcidae)

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(*Presented at the meeting of August 13, 1956*)

As Zimmerman (1948) has pointed out, the endemic pseudococcid fauna of the Hawaiian Islands, although it is poorly known, contains a number of unusual and interesting forms. One such species is *Pedronia hawaiiensis* Ferris, which was described from a single small collection taken from the fronds of the widespread and pestiferous exotic fern *Dicranopteris linearis* (Burmeister) Underwood. Four additional species allied to *P. hawaiiensis* have been discovered recently and are described in this paper. Still others in this group doubtless await discovery by careful collectors, particularly on the islands other than Oahu. These mealybugs are not likely to be taken in the course of indiscriminate general insect collecting as their small size and cryptic habits render them very inconspicuous. Two of the species described here were found on the slopes of Mt. Tantalus, Oahu, which is probably one of the most thoroughly collected areas in the Hawaiian Islands. Two species are known only from herbarium specimens of their hosts.

All the Hawaiian members of the genus *Pedronia* so far discovered are attached to ferns. Four have been found associated with false staghorn ferns (*Dicranopteris* spp.) and one with a tree fern, *Cibotium chamissoi* Kaulfuss. That two species are known only from the exotic *D. linearis* seems an unusual host relationship for what appear to be endemic Hawaiian insects. Presumably, the original hosts of these mealybugs were native species of *Dicranopteris* or other native ferns, and they have successfully adapted themselves to the immigrant species. It is likely that these mealybugs eventually will be found infesting native hosts.

The genus *Pedronia* was erected by Green (1922) to receive a single species, *P. strobilanthis* Green, from Ceylon. The host of the genotype is given as *Strobilanthis* sp., a member of the spermatophyte family Acanthaceae. Ferris (1948) redefined the genus and described the second known species, *P. hawaiiensis*, from Oahu. Professor Ferris has very kindly examined specimens of the first two species described here and considers them congeneric with *P. hawaiiensis*. It seems possible that the Hawaiian species are not closely allied to the Ceylonese genotype, and, perhaps, ultimately a new genus

should be erected for them. However, following Professor Ferris' suggestion, I am broadening the concept of the genus *Pedronia* to accommodate the newly discovered forms.

As understood here, the genus *Pedronia* includes pseudococcids that possess two to seventeen definite pairs of cerarii. Some cerarii, at least the posterior two to four pairs in the known species, have two or more large, stout, conical setae set close together. Such setae are also present in rows on the dorsum in the genotype but not in any known Hawaiian species. Antennae six- or seven-segmented. Tarsal claws without a tooth.

Dorsal ostioles usually present, but reduced or apparently absent in mature females of some Hawaiian forms. Circulus entirely wanting in all known species. Tubular ducts absent in all species; multilocular disc pores absent in all known Hawaiian forms, but small numbers of these present in the genotype (Ferris, 1948). Trilocular pores present on the venter and usually on the dorsum. In two of the Hawaiian species the number of dorsal triloculars is reduced to a very few. Anal ring small but well developed, bearing the usual six setae.

The distinctive features of the genus seem to be the presence of the unusually large, stout, conical setae associated with at least some of the cerarii, and the absence of circuli and tubular ducts. The known Hawaiian species differ from the Ceylonese genotype in that they all apparently lack multilocular disc pores and stout conical setae on the dorsum. However, in two of our species most of the dorsal setae are enlarged, their basal diameter being considerably greater than that of ordinary body setae. The Hawaiian species all show some tendency to develop sclerotized prominences which bear those cerarii that possess the larger conical setae. In one of the species which is described here the entire derm becomes heavily sclerotized at full maturity.

Trilocular pores are present on at least the anal pair of cerarii in all but one of the known Hawaiian species. In three of our species several such pores are situated between and around the larger conical setae of the more strongly developed cerarii. These pores are probably the orifices through which the wax pencils associated with these cerarii are secreted.

## Key to the Known Hawaiian Species of Pedronia

1. Anal cerarii each with seven or more stout accessory conical setae which extend in an arc nearly to, or across, the mid-dorsal line of the ninth abdominal segment anterior to the anus; dorsal body setae of abdomen enlarged . . . . . 2

   Anal cerarii each with but two large conical setae; dorsal body setae of normal form . . . . . 3

2. With but two pairs of abdominal cerarii bearing stout conical setae;

accessory conical setae of ninth abdominal segment of nearly uniform size, forming a closely packed phalanx which extends across the mid-dorsal line; trilocular pores numerous on anterior portion of dorsum . . . . . **acanthocauda,** n. sp.

With seven or eight pairs of abdominal cerarii bearing stout conical setae; accessory conical setae of posterior margin of ninth abdominal segment becoming smaller toward the mid-dorsal line, where they are usually discontinuous; trilocular pores of dorsum very few . . . . . **crypta,** n. sp.

3. With seventeen definite pairs of cerarii, all except the anal pair normally with four large conical setae (although the number on anterior pairs may vary from three to five); on *Cibotium* . . . **cibotii,** n. sp.

With sixteen or fewer definite pairs of cerarii, each normally bearing two conical setae; on *Dicranopteris* . . . . . 4

4. With sixteen definite pairs of cerarii, the conical setae of all of about equal size; sclerotization of derm at full maturity confined to cerarii; without cephalic humps . . . . . **hawaiiensis** Ferris

With eleven to fourteen pairs of cerarii, conical setae of those anterior to the last three or four reduced, variable, or absent; derm completely sclerotized at full maturity; with a rounded cephalic hump bearing a cerarius at its apex located on either side of the midline between the antennae . . . . . **dura,** n. sp.

**Pedronia hawaiiensis** Ferris

I have collected this species on the Manoa Cliff Trail, Mt. Tantalus, Oahu; Wiliwilinui Ridge, Oahu; and on Mt. Kaala, Oahu. A few trilocular pores, usually from two to six, are present on each cerarius around the bases of the conical setae of all my specimens. These are not indicated in Ferris' figure, but are present on the paratype specimens at the Bishop Museum. In one specimen from Wiliwilinui Ridge there are three conical setae on one of the anterior cerarii.

Wherever I have found this species it has been associated with a particular deformation of the fronds of the host fern, *Dicranopteris linearis.* This takes the form of a rosette of pinnules and is produced by the tight coiling of the midrib of a branch pinna (fig. 1). The mealybugs are usually found within these rosettes, particularly on the undersurfaces of the pinnules near the midrib. Whether this deformation is actually a result of the feeding of the mealybugs or whether they merely take advantage of the concealment which the deformed fronds afford was not determined.

Mature living females of *Pedronia hawaiiensis* are pale yellow in color, oval in outline, and quite flat. The dorsal surface is smooth, shining, and almost devoid of mealy wax. Two rather thick pencils of glassy wax extend from each cerarius. These lie together so as to appear as a single, wide, longi-

tudinally divided pencil. The length of the longest wax pencils is equal to about one-third the width of the dorsum, but is shorter in immature individuals. Except for the anterior three or four pairs, these wax pencils are all directed posteriorly, and those in the midregion lie close to and nearly parallel with the lateral margins of the body. This unusual arrangement of the wax pencils appears to be due to the posteriorly directed orientation of the cerarian conical setae.

Mature females are about 1.5 mm. long and just under 1 mm. wide. There is usually a small amount of powdery wax on the pinnule surface beneath gravid females, but no sign of any ovisac. This appears to be an ovoviviparous species, as no eggs were ever found. Male cocoons were commonly found with females within coils of deformed pinnules, and a number of small, gray, winged males were reared.

A tiny black species of *Anagyrus*, probably an undescribed endemic form, was reared from females of *Pedronia hawaiiensis* collected on Mt. Tantalus and Wiliwilinui Ridge, Oahu. The larvae of a cecidomyiid midge, determined by Dr. D. E. Hardy as *Trisopsis* sp., were found preying on these mealybugs in *Dicranopteris* fronds from Mt. Tantalus.

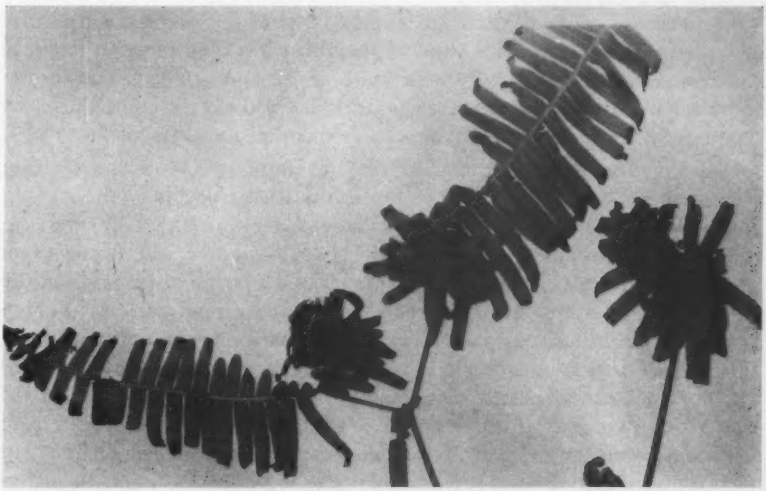

FIG. 1. Rosette deformation of *Dicranopteris linearis* fronds associated with presence of *Pedronia hawaiiensis* Ferris.

**Pedronia cibotii,** new species (fig. 2)

Female. With seventeen definite pairs of cerarii, each, excepting the anal pair, borne on a low, rounded, slightly sclerotized prominence. Anal cerarii each with two large, stout, conical setae, surrounded by an elongate-oval sclerotized area bearing two or three slender accessory setae. Remaining cerarii each typically with four stout conical setae, the two central ones slightly larger than the others; occasionally three or five conical setae on some cerarii, particularly those on the head and thorax. Dorsum and venter with scattered small trilocular pores, a few such pores present on each cerarius around the bases of the conical setae. Ventral side of anal lobes slightly sclerotized at apex. Dorsum and venter with scattered slender setae. Antennae six-segmented in all specimens at hand.

Length of last-stage females on slides: 1.2–1.7 mm.

Described from 23 slide-mounted specimens (holotype and 22 paratypes on 12 slides) from tree fern, *Cibotium chamissoi*, Manoa Cliff Trail, Mt. Tantalus, Oahu, January 2 and January 22, 1956, J. W. Beardsley collector. Holotype and 12 paratypes in the collection of the Experiment Station, H.S.P.A., Honolulu; 10 paratypes in the Bernice P. Bishop Museum, Honolulu.

The diameter of the bases of the conical setae of this and the three other new species described in this paper is somewhat less than those of *Pedronia hawaiiensis*, so that these setae appear more slender and elongate. The normal complement of four conical setae per cerarius and the seventeen pairs of cerarii serve to distinguish this species from other members of the genus.

Living mature females of this mealybug are lemon yellow in color, broadly oval in shape, and nearly flat. The dorsum is almost devoid of mealy wax. Short, fine pencils of glassy wax arise from each cerarius. Typically, there are four such wax pencils at each cerarius: a central pair arising from the larger central pair of conical setae, plus an anterior and a posterior pencil from the slightly smaller anterior and posterior setae. The central pair are roughly perpendicular to the body and lie closely appressed throughout their length so that they appear as a single longitudinally divided pencil. The anterior and posterior pencils extend diagonally from the cerarii. The length of the central pencils is equal to about one-sixth the maximum width of the dorsum of the mealybug, while the anterior and posterior pencils are about one-half to two-thirds as long as the central pair. Two wax pencils, which appear as a single longitudinally divided filament, arise from each anal cerarius and extend backward a distance about equal to the length of the longer lateral pencils.

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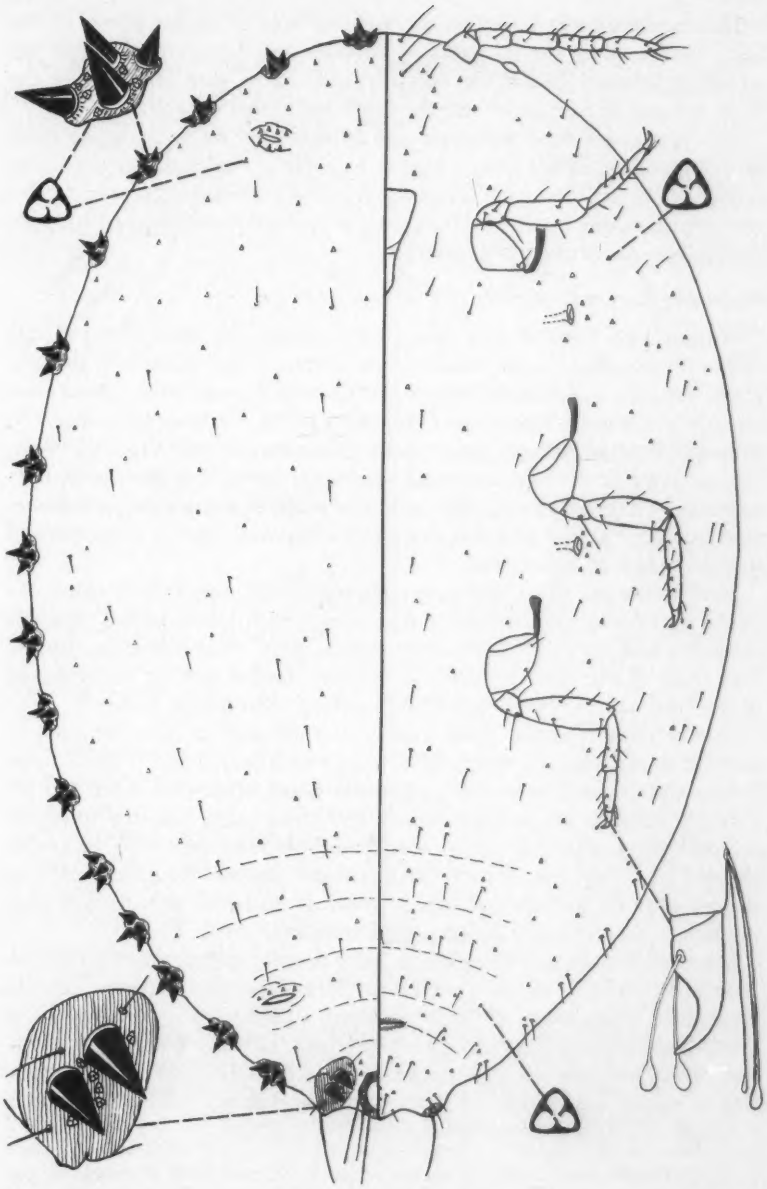
FIG. 2. *Pedronia cibotii*, n. sp. Dorsal and ventral aspects and details of mature female.



This mealybug was found on the undersurfaces of mature fronds of the host, usually along the midveins of pinnules near where these joined the midrib of a branch pinna. Occasionally, individuals were found along the outer margins of pinnules where the edges had curled over slightly.

This species produces no ovisac and females were observed giving birth to living young. White male cocoons were fairly numerous on the under surface of infested host fronds, and a number of grayish, winged adult males were reared. A tiny black *Anagyrus*, another apparently undescribed endemic species, was reared from this mealybug.

**Pedronia dura,** new species (fig. 3)

Female. With 11 to 14 discernible pairs of cerarii, the three posterior pairs each with two large stout conical setae. Anterior abdominal and thoracic cerarii variable, each usually with a pair of stout conical setae. These setae variable in size but always smaller than those of the last three pairs of cerarii, although those of the sixth abdominal segment may be only slightly smaller. Conical setae of the anterior cerarii sometimes unequal in size; sometimes represented only by a pair of fine setae like those of the dorsum, sometimes with one conical seta and one fine seta; often with one or more pairs of thoracic cerarii entirely absent.

Head with a pair of forward-projecting rounded humps, one on either side of the mid-dorsal line between the antennae; each hump bearing a single cerarius which consists of two stout conical setae, these somewhat smaller than those of the posterior abdominal cerarii. Cerarii lacking in the region of the head and prothorax immediately behind the cephalic humps.

One or more trilocular pores associated with each cerarius; the greatest number on the posterior cerarii, the anal pair each having 6 to 12 such pores. Venter with numerous scattered trilocular pores, somewhat more concentrated posteriorly. Slight concentrations of these pores near the spiracular orifices. Dorsal trilocular pores, other than those associated with the cerarii, reduced to a very few; 2 to 12 or so usually discernible. A few scattered slender setae on dorsum and venter; those of venter of two distinct sizes, the longer ones arranged in incomplete transverse rows.

Derm at full maturity becoming quite heavily sclerotized throughout. Anal lobes of fully mature individuals developing into flattened flap-like projections which meet, or nearly so, along an extension of the mid-dorsal line behind the anus (fig. 3, b). Derm of young last-stage females not sclerotized, the anal lobes less strongly produced, although a thin flap-like extension is usually discernible (fig. 3, a). Antennae with six or seven segments.

Length of last-stage females on slides: 1.4–1.7 mm.

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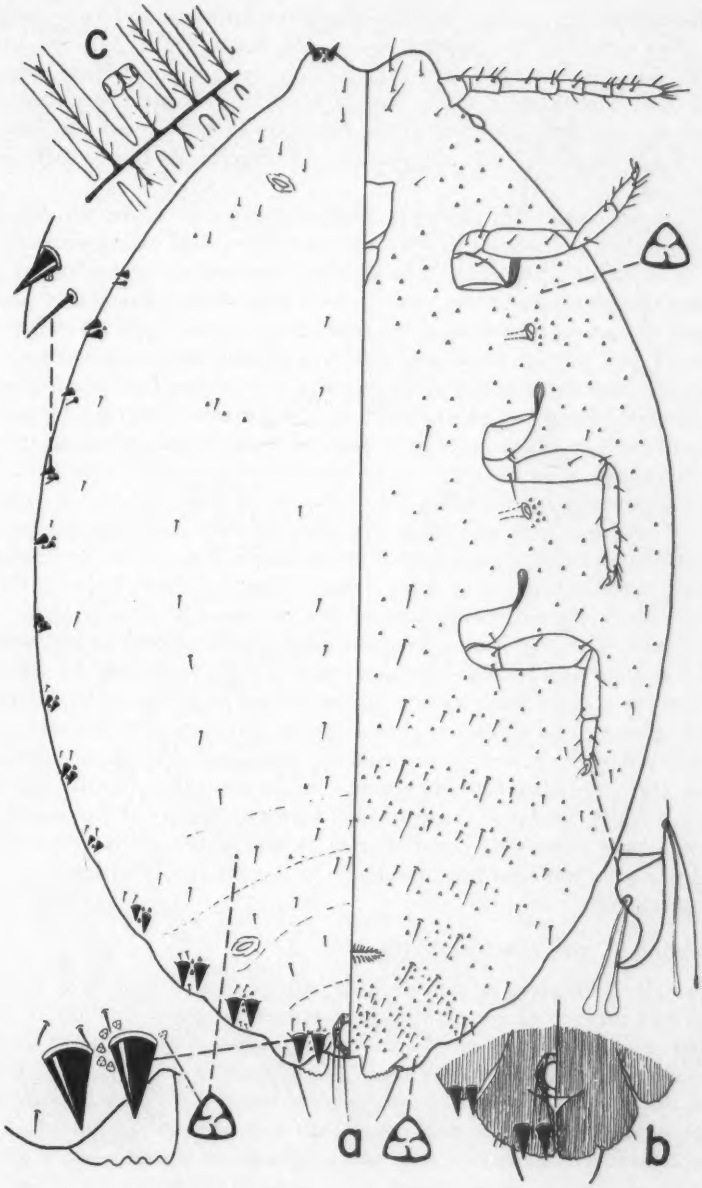
FIG. 3. *Pedronia dura*, n. sp. *a*, dorsal and ventral aspects and details of young last-stage female; *b*, dorsal and ventral aspects of anal lobes of fully mature female; *c*, portion of a *Dicranopteris linearis* frond showing deformed pinnule associated with presence of *P. dura*.


C
a
b

Described from 16 slide-mounted specimens. Holotype and five paratypes on three slides: ex *Dicranopteris linearis*, Mt. Kaala, Oahu, May 20, 1956, J. W. Beardsley collector. Ten paratypes on six slides: same host, Manoa Cliff Trail, Mt. Tantalus, Oahu, January 22, 1956, J. W. Beardsley collector. Holotype and nine paratypes in the collection of the Experiment Station, H.S.P.A., Honolulu; six paratypes in the Bernice P. Bishop Museum, Honolulu.

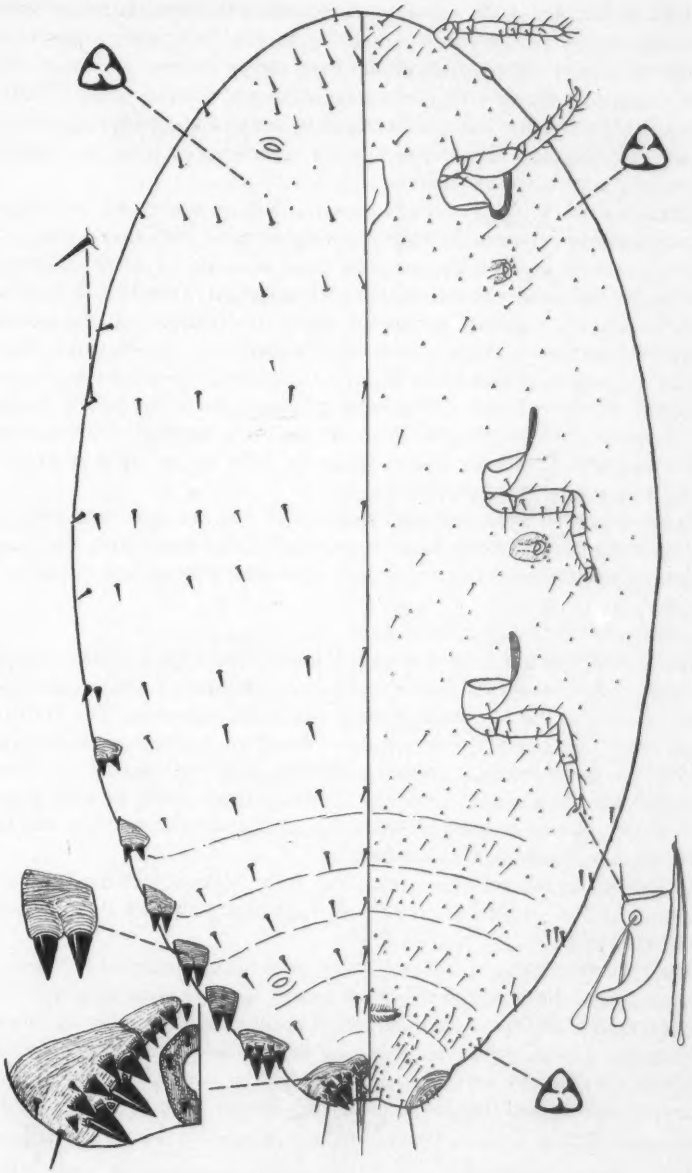
Wherever found, this species is associated with a particular deformation of the host fern. The mature mealybugs are always found within what appear to be incompletely unrolled pinnule tips. Apparently, the feeding of the young mealybugs aborts the unrolling of the developing pinnules of young fronds and results ultimately in the formation of a hard, gall-like roll at the apex of each pinnule so affected (fig. 3, c). Within each such roll are two chambers, one on either side of the midvein, either one or both of which may be inhabited by an individual mealybug. The presence of this species can be spotted easily on plants in the field, as the aborted pinnules of mature fronds are conspicuously shorter than those which have developed normally.

Young mealybugs, including the immature last-stage females, are yellow-orange in color, oval, and rather flat, with the two small cephalic humps discernible in front of and between the antennae. Wax pencils are confined to the posterior three or four pairs of cerarii. Those of the anal pair are about two-thirds as long as the maximum width of the dorsum; the anterior pencils are shorter. The fully mature females of this species become heavily sclerotized and are dark reddish-brown in color. At this stage they lie seedlike within the aborted pinnules and apparently are incapable of locomotion. This appears to be an ovoviviparous species. No eggs or ovisac were ever found, although crawlers were frequently associated with mature females. Male cocoons occasionally were found within the rolled pinnule tips, and winged males, similar to those of other Hawaiian species of *Pedronia*, were reared. An endemic *Anagyrus*, the same or very similar to that reared from *P. hawaiiensis*, was bred from specimens of this mealybug collected on Mt. Tantalus, Oahu.

**Pedronia crypta,** new species (fig. 4)

Female. With seven or eight definite pairs of cerarii, those of abdominal segments three to nine present in all specimens at hand. Anal cerarii each within a definitely sclerotized area which extends in an arc nearly to the mid-dorsal line in front of the anus. The six pairs of cerarii anterior to the anal pair each borne on a sclerotized prominence. Each cerarius with two large, stout, conical setae. Anal cerarii each with seven to ten smaller accessory conical setae of various sizes which form an arc reaching nearly to the

FIG. 4. *Pedronia crypta*, n. sp. Dorsal and ventral aspects and details of mature female.



mid-dorsal line within the extended sclerotized area. Penultimate cerarii each with two to four such accessory conical setae. Anterior pairs usually without accessory conical setae (although in one paratype there is one such seta on each cerarius of the seventh abdominal segment). Conical setae of anterior cerarii slightly smaller than the large pair of the anal and penultimate cerarii. Cerarii of the second abdominal segment sometimes lacking, if present not borne on a sclerotized prominence.

Cerarii without visible concentrations of trilocular pores, with but one such pore discernible between the largest conical setae of each anal cerarius. Trilocular pores of the dorsum few, not more than six or seven discernible, scattered in the vicinity of each anterior dorsal ostiole. Ventral trilocular pores fairly numerous, scattered, somewhat more concentrated on the posterior abdominal segments. Pores concentrated slightly around spiracular orifices.

Ventral portion of anal lobes slightly sclerotized. Spiracles each enclosed in a small sclerotized area. Dorsal setae enlarged, thickened basally, those of the abdomen arranged roughly in transverse rows. Setae of venter scattered, of normal form except for a few similar to those of the dorsum along the lateral margins of the abdomen.

Antennae rather short, six-segmented in all but one specimen (that with one six-segmented and one seven-segmented). Legs, particularly the femora, appearing shorter and stouter than in the previously described species of the genus.

Length on slides: 1.7–2.3 mm.

Described from five fully mature specimens (holotype and four paratypes on three slides) recovered from a herbarium specimen of *Dicranopteris owhyhensis* Hooker in the Bernice P. Bishop Museum, Honolulu. The herbarium sheet bears the following information: Board of Agriculture and Forestry Herbarium; number 4047; collector, Brodie; locality, Kauai. The collector was probably the late Mr. Alexander Brodie, a chemist and amateur botanist who was employed at a sugar plantation on Kauai prior to 1918. No more exact locality information is available.

Holotype and two paratypes deposited in the collection of the Experiment Station, H.S.P.A., Honolulu; two paratypes in the Bernice P. Bishop Museum, Honolulu.

The type specimens of this mealybug were found in aborted, rolled-over pinnule tips of the host fern which are similar to those produced by *Pedronia dura* on fronds of *Dicranopteris linearis*. A number of male cocoons, presumably of this species, were present on the under side of the frond from which the female specimens were recovered.

Several mummified females showing parasite exit holes were found on the

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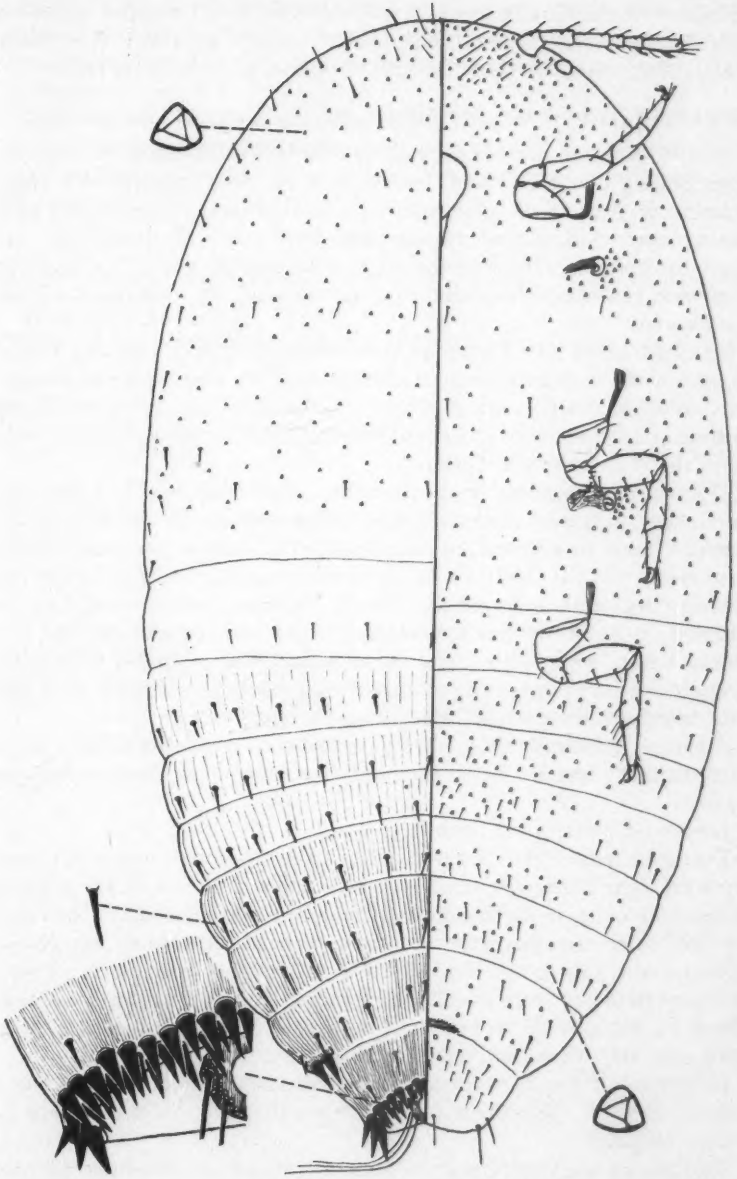
FIG. 5. *Pedronia acanthocauda*, n. sp. Dorsal and ventral aspects and details of mature female.



herbarium specimen with the type material. One intact mummy yielded a fully developed, but slightly teneral, female *Anagyrus*, apparently an endemic species allied closely to those reared from species of *Pedronia* on Oahu.

**Pedronia acanthocauda,** new species (fig. 5)

Female. With but two definite pairs of cerarii, those of abdominal segment eight bearing two large, stout, conical setae set close together on a small prominence. Anal cerarii represented by a solid phalanx of about forty such conical setae which extend, two or three deep, across the mid-dorsal axis along the posterior margin of the ninth abdominal segment. That segment somewhat produced posteriorly, causing the anal ring to appear slightly invaginated.

Trilocular pores fairly numerous, scattered on dorsum of head and thorax, apparently absent from dorsum of abdomen and the cerarii. Numerous scattered trilocular pores on venter of head and thorax, becoming less numerous or absent on the posterior abdominal ventrites. Slight concentrations of these pores about the spiracular openings.

Dorsum of abdominal segments six to nine rather heavily sclerotized throughout, segments three to five less noticeably so. Dorsal ostioles apparently absent in mature females (although the anterior pair is discernible in several nymphs at hand). Dorsal abdominal setae, particularly those of the posterior segments, enlarged and basally thickened, arranged roughly in transverse rows. A few less noticeably enlarged setae present on head and thorax. Ventral setae rather sparse and of normal size, except for a few more strongly developed ones along the lateral margins of the abdomen. Anal ring well developed, the usual six setae unusually long.

Antennae moderately short, six-segmented in all specimens at hand. Legs, particularly the femora, rather short and stout, resembling those of *Pedronia crypta*.

Length on slides: 1.4–2.1 mm.

Described from eight fully mature specimens (holotype and seven paratypes on eight slides) recovered from herbarium specimens of *Dicranopteris owhyhensis* Hooker in the Bernice P. Bishop Museum, Honolulu. The holotype and three paratypes were taken from material collected on Mt. Konahuanui, Oahu, July 3, 1872, by Hillebrand and Lydgate. Four paratypes were recovered from host material collected at the peak of Mt. Konahuanui, Oahu, March 14, 1920, by D. W. Garber. A number of immature or inferior specimens were also taken from these herbarium sheets.

Holotype and three paratypes deposited in the collection of the Experiment Station, H.S.P.A., Honolulu; four paratypes deposited in the Bernice P. Bishop Museum.

This species was found within the same sort of aborted, rolled-over pinnule tips as were *Pedronia dura* and *P. crypta*. Although some of the specimens,

including the holotype, were nearly 85 years old when removed from the host material, they were still in excellent condition. This certainly is evidence of the excellent care which the Bishop Museum herbarium has enjoyed these many years.

*Pedronia acanthocauda* seems to be closely allied to *P. crypta* from Kauai, and also, although less obviously, to *P. dura*. Both *P. acanthocauda* and *P. crypta* probably still occur in the more remote mountain areas where their host is found.

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# A New Species of Conicera (Diptera: Phoridae) from Hawaii, with Observations on the Genera Parafannia Bohart and Gymnoptera Lioy

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UPTON-BY-CHESTER, ENGLAND

(*Presented at the meeting of October 8, 1956*)

In 1954, Dr. D. E. Hardy of the College of Agriculture, University of Hawaii, Honolulu, Hawaii, mentioned to me that the Hawaiian Phorid fauna included only one species of *Conicera* known to him and that this had been recorded as *C. atra* Meigen. He discussed with me the question of the correctness of this name, to which Schmitz (1929) had given preference over that of *C. dauci* (Meigen) used by Lundbeck (1922). Father Schmitz, to whom I referred the matter, consulted Prof. Dr. R. Richter (the author of EINFÜHRUNG IN DIE ZOOLOGISCHE NOMENKLATUR DURCH ERLÄUTERUNG DER INTERNATIONALEN REGELN, Frankfurt am Main, 1948) who expressed the opinion that in 1833 Haliday, as the first revising author, had unquestionably wished *Conicera atra* Meigen to be made a synonym of *Phora dauci* Meigen. Therefore it emerged that the name *C. dauci* (Meigen) should be revived and *C. atra* Meigen once more sink as a synonym.

The record of *C. atra* Meigen to which Dr. Hardy had referred emanated from Bryan (1923), on material from Oahu, March, 1916, bred from rotten potatoes and determined by Knab. Until that time, Dr. Hardy had tentatively assumed that the *Conicera* which he had taken from time to time on windows was that species. He sent me some specimens in 1955 from which I could immediately see that they were certainly not *dauci* (Meigen) since they clearly belonged to the subgenus *Tritoconicera* of Schmitz (1952), in which the males have a very characteristic sense-organ on the mid-femora, not present in *dauci*. Early this year, Dr. Hardy kindly sent me some more material, including the original specimens upon which Bryan's 1923 record was based and three males (determined as *C. atra* Meigen by Joyce, 1954), all of which proved to be conspecific with Dr. Hardy's *Tritoconicera* species. Also included in the consignment was a female Phorid determined by Joyce as *Parafannia molluscovora* Bohart, from decaying shellfish on the beach, Honolulu, Feb. 9, 1952, concerning which Dr. Hardy expressed considerable doubt, thinking it to be nothing more than the *Tritoconicera* species in question; and so it proved to be. (With the consignment Dr. Hardy had very kindly included some of the Guam paratypes of *Parafannia molluscovora* from the Bishop Museum, in spirit, with larvae and pupae, and of these more will be said

later.) It was clear, therefore, that the records of *Conicera dauci* and *Parafannia molluscovora* must be erased from the Hawaiian list. Further investigation of the *Tritoconicera* species, now that female material was available, showed that it had been hitherto undescribed, and for it I propose the name

**Conicera (Tritoconicera) hawaiiensis,** new species

Male. A very small species having some affinities with *breviciliata* Schmitz (1926) but adequately distinguishable therefrom in the male by sexual characteristics of the mid-femora and genitalia (fig. 1, A-C, cf. Schmitz, 1952, textfigs. 162 and 167 c, d). Frons dull black, with slight greyish sheen; ratio of median length from vertex to supra-antennals against width of frons about 3:5. Eyes shortly but evidently hairy. Antials somewhat closer together, a little shorter and less stout than the preocellars; the mediolaterals shorter and weaker than either, and further from the preocellars than the preocellars are from one another. Anterolaterals wanting, characteristic of the subgenus. The middle row slightly convex anteriorly, not concave as Schmitz states of *breviciliata*. Third antennal segment (fig. 1, D) brown to reddish-brown with short, pale, shining pubescence, about 2¼ times as long in profile as it is broad at the widest part; elongated-conical, reminiscent of *dauci* in general shape. Arista about one-third longer, very evidently pubescent. Palpi yellowish-brown to darker brown, especially basally, rather dilated from middle to apex, with very short bristles; about one-half the length of the third antennal segment.

Thorax dark brown to black on the dorsum with a faint greyish sheen; pubescence black but shining pale golden in an intense light; pleura paler, blackish brown. Legs generally brown, the front legs including the coxae paler; the mid- and hind femora darker, blackish-brown. Front tibia with the usual small sub-basal postero-dorsal bristle and row of setulae. Length of fore-tibia almost exactly four-fifths of that of the fore-tarsi, the segments of which increase consistently in breadth in the direction of the apex, so that the apex of the fifth segment is noticeably wider than the base of the metatarsus—but not so wide as the apex of the tibia. Relative lengths of foretarsal segments 36:18:17:13:16, thus differing considerably from *breviciliata*. The sense-organ, characteristic of the subgenus, on the posterior face of the mid-femora (fig. 1, C) differs from *breviciliata* (Schmitz, 1952, textfig. 162) in the longer, thinner form of the pale brown, shining, tubular spur-process (Hohlsporn), but the smaller fovea (Grübchen) within the larger shining, hairless, bristle-encircled depressed area is not quite so narrow, about 3–3½ times as long as wide and broadly rounded at the proximal end. The fissure (Längsspalt) or channel connecting it to the spur-process appears to be within a somewhat raised and narrow plateau-like area; this, however, may be merely the result of exsiccation. Hind femora 3–3½ times longer than wide; hind tarsi a little more than 1½ times longer than the hind tibiae;

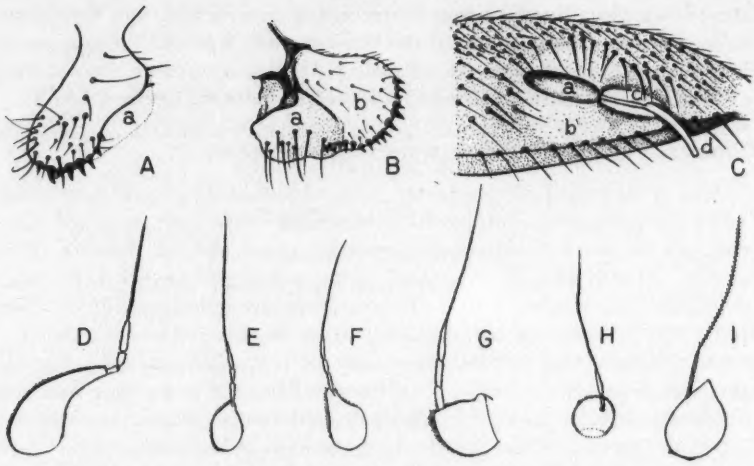


FIG. 1. A, *Conicera* (*Tritoconicera*) *hawaiiensis*, n. sp., ♂, hypopygium, left clasper; *a*, hairless area. B, *id.*, right clasper; *a*, proximal lobe; *b*, distal lobe. From macerated specimen. C, *id.*, mid-femur, posterior face, showing special sense-organ; *a*, smaller fovea (Grübchen); *b*, larger depressed area; *c*, raised area; *d*, tubular spur-process (Hohlsporn). From dried specimen, partly diagrammatic. Third antennal segment and arista. D, *Conicera* (*Tritoconicera*) *hawaiiensis*, n. sp., ♂. E, *id.*, ♀. F, *Gymnoptera orientalis* (de Meijere), ♂. G, *Gymnoptera vitripennis* (Meigen), ♀. H, *Gymnoptera* (= *Parafannia*) *molluscovora* (Bohart), ♀; "basal plane" indicated by dotted line. I, *Citrago citreiformis* (Becker), ♂. D–G and I, profile; H, from above.

the metatarsus exactly two-thirds of the length of the hind tibia; tarsal segments steadily decreasing in width apically, the fifth only one-third as wide as the metatarsus; ratios of lengths of tarsal segments 40:21:15:12:12. Wing (fig. 2, A), very faintly tinged with greyish, almost hyaline, thick veins brown, thin veins hardly pigmented, a little more than twice as long as wide (2.1 times). Costal index 0.40. Ratio of costal segments 106:48 or 21:10, i.e., 1 just over twice 2. Costal cilia very short, the longest not exceeding 0.047 mm.

Abdomen of the usual shape, narrowed posteriorly, velvety black with slight greyish sheen, in some specimens the hind margins of the segments narrowly paler; venter a little less dark; no evident bristles. By contrast, the hypopygium, which is prominent in size, is of a dingy yellowish-brown, a little shining basally, with numerous very fine, short hairs on the sides. The claspers or hypopygial forceps (the "Zangenarme" of Schmitz) as in fig. 1, A, B, the left with the hairless area, indicated by a dotted line, rather more elongated and narrow than in *breviciliata* (Schmitz, 1952, textfig. 167 d) and with a double row of the usual black stubby spinules ("papillen" of Schmitz), only one of these being visible in the figure, the other beyond the margin; the right having the proximal lobe relatively larger than in *breviciliata*, thus

the general outline rather more resembling *tibialis* (Schmitz, 1952, textfig, 167 b), otherwise very similar (cf. Schmitz, 1952, textfig. 167 c).

Length 0.9–1.3 mm.

Female. Generally coloured more uniformly dark-brownish, rather than black, than in the male, with somewhat paler pubescence, but this may be due to immaturity of some of the type material. Frons about 1½ times wider than high; the antials about as far apart as the preocellars. Supra-antennals somewhat vaiable in length but not longer than in the male as Schmitz says of *breviciliata*. Second row slightly convex anteriorly; mediolaterals again slightly weaker than the preocellars and further from them than the preocellars are from one another. Third antennal segment (fig. 1, E) small, lemon-shaped; the arista inserted almost apically and about 4 times the length of the third antennal segment. Palpi paler, yellowish or orange, and larger than in the male with relatively longer and stronger bristles, but of similar shape. Sixth abdominal tergite an isosceles triangle, with blunt apex, the length about 1½ times to twice the width of the base, but this appearing variable due to exsiccation. Fore tarsi not increasing in width apically. Ventral spur on mid-tibiae only about two-thirds of the length of the mid-metatarsi, and that on the hind legs about one-third. Wings of same shape as in the male—costal index 0.45–0.46. Ratios of segments 16:10, i.e., 1 much less than double 2. Costal cilia exceptionally short (0.037 mm.), i.e., even shorter than Schmitz states of *breviciliata*; the dorsal row not quite reaching the apex of vein 2; the second costal segment bearing 7 cilia of the lower row (Schmitz states 6 of *breviciliata*). Third vein thicker than the costa (0.020, 0.017 mm. respectively); the seventh practically reaching the margin.

Length 1.3 mm.–1.5 mm.

Schmitz (1952) draws some distinctions between Brues' (1911) description of *formosensis*, known only from the female, and his own very fully detailed description of *breviciliata*. All of these distinctions apply to *hawaiiensis*, n. sp., relative to *formosensis*, but it can be stated additionally that whereas the pubescence on the dorsum of the thorax is dark in normal direct light and shines pale golden in more intense oblique lighting, contrasting with the darker ground colour of the integument, there is certainly no duplicated system of pubescence, or what Brues describes as a finer glaucous pubescence.

Holotype ♂, Honolulu, Oahu, January, 1953, D. E. Hardy, on window. Allotype ♀, Oahu, March, 1916, J. Illingworth, ex rotten potato; one (indicated by red arrow) of four specimens pinned on card. Paratypes, ♂♀, about 40 specimens stuck on card, details as allotype; 8 ♂♂, details as holotype; 2 ♂♂, February, 1952, otherwise as above; 2 ♂♂, October, 1953, otherwise as above; 1 ♀, Feb. 9, 1952, 2♂♂, March 9–11, 1954, 1 ♂, Jan. 28, 1955, Honolulu, Oahu, C. R. Joyce; 1 ♂, Honolulu, Oahu, Jan. 24, 1952, M. S. Adachi, on window. Holotype in U. S. National Museum; allotype (no. 2237) and other paratypes in Bernice P. Bishop Museum; para-

types in the British Museum (Natural History) and the collections of the University of Hawaii, Father H. Schmitz, and the author.

As regards the paratype material of *Parafannia molluscovora* Bohart, the most immediately striking feature was the phenomenal likeness of the larvae (incidentally strongly reminiscent of those of *Fannia*, Muscidae, and doubtless inspiring Bohart's generic name, although not, at the time, described or figured by him) to those of *Gymnoptera orientalis* (de Meijere) (*vide* Schmitz, 1952, textfig. 169). In fact, I was unable to find any really satisfactory characters for distinguishing the two. This of course led to a comparison of the wings of the adult material with species of *Gymnoptera* (tropical material kindly given by Father Schmitz), with the discovery that Bohart's (1947) fig. 46 of *P. molluscovora* was certainly inaccurate as regards the course of the fourth vein (*vide* fig. 2, G, prepared from photograph), the number of costal cilia, and certain other minor particulars. The wing was obviously that of a *Gymnoptera*, and the only one of Bohart's generic characters to distinguish *molluscovora* from a species of that genus was "arista inserted dorsally." Bohart had described the third antennal segment of his female type material (only the female being known up to the time of this paper) as sub-spherical, which his figure also indicates; the profile view illustrates what, presumably, he meant by "inserted dorsally," but the anterior view leaves much room for doubt. My examination of the paratype material led me partly to agree with his description, but not with his figure. The shape of the third antennal segment, I found, was somewhat variable and obscured by pubescence in some cases; but I considered that "sub-spherical" was an accurate description in that it was not possible for me to discern an "apex" to the third antennal segment; nor, consequently, to say positively that the insertion of the arista was "dorsal," or "apical." All the type material is in spirit; and so some illusions are created not infrequently in such matters which might conceivably be dispelled by seeing pinned material. Certain it was that if the arista in a specimen of *molluscovora* were to be extended in a direction vertical to the plane of the junction of the third and second antennal segments, it would appear "apical"; were it to be extended in some other direction relative to that plane it would appear "dorsal," as in most cases it does in fact (fig 1, H); the figure is prepared from a photograph and the "plane" indicated by a dotted line.

Bohart had indicated in his generic description that *Parafannia* "runs close to *Citrago* Schmitz in his key to the world genera (1929)." It seems abundantly clear that he was led to this conclusion by couplet 12 of this key, whereas if he had considered that the insertion of the arista in his types was apical, he would have certainly been led to *Gymnoptera* and thence, by the synonymy, to Lundbeck's wing-figure (p. 178) of *vitripennis*. There seems to have been considerable difference of opinion between authors on this question of the apical or other insertion of the arista in the genotype of *Gym-*

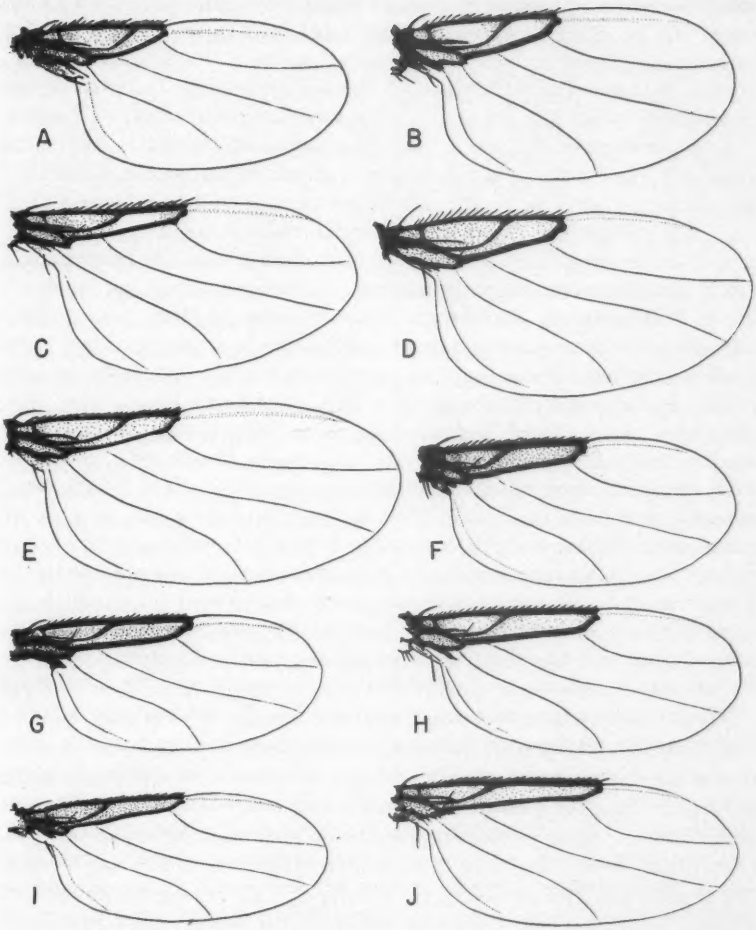


FIG. 2. Wings. A, *Conicera* (*Tritoconicera*) *hawaiiensis*, n. sp., ♂. B, *Gymnoptera orientalis* (de Meijere), ♂. C, *Gymnoptera longicostalis* Schmitz, ♂. D, *Gymnoptera simplex* (Brues), ♂. E, *Gymnoptera vitripennis* (Meigen), ♂. F, *Gymnoptera orientalis* (de Meijere), ♀. G, *Gymnoptera* (= *Parafannia*) *molluscovora* (Bohart), ♀. H, *Gymnoptera simplex* (Brues), ♀. I, *Gymnoptera vitripennis* (Meigen), ♀. J, *Gymnoptera longicostalis* Schmitz, ♀.

*noptera* Lioy, i.e., *vitripennis* (Meigen). Becker (1901) says of it (as a *Phora*) on p. 71, ". . . aber die Fühlerborste ist nicht endständig, sondern deutlich ruckenständig"—he was referring to males. Lundbeck (1922) says of his conception of *Hypocera* Lioy (in which he included *vitripennis*), ". . . arista dorsal, in *vitripennis* rather sub-apical . . ." and even says, on p. 181, of *Conicera*, ". . . it comes especially near to (*Hypocera*) *vitripennis* with its . . . sub-apical arista and it is just possible that *vitripennis* should be placed in *Conicera* . . ." But Schmitz (1929) on p. 122 says of his conception of *Gymnoptera* Lioy, ". . . mit apikaler . . . Arista. Bei der melanesischen Art ist die apikale Insertion der Arista ganz evident; bei den europäischen kann die Entscheidung durch die Fühlerform (lange Vorderseite, kurze Hinterseite) und durch die starke Pubeszenz der Vorderseite etwas erschwert werden; gut erhaltene Exemplare mit nicht geschrumpftem 3. Fühlergliede zeigen auch hier meist zweifellos apikale Einlenkung." He repeats this more or less verbatim later (1952). Hitherto there have been four species of *Gymnoptera* known, viz., *vitripennis* (Meigen) and *longicostalis* Schmitz from Europe, *orientalis* (de Meijere, 1907, as a *Syneura*) from Java, and *simplex* (Brues, 1905, as a *Conicera*), the last named being the Melanesian species to which Schmitz was referring. Reference to Schmitz' Taf. I. 9, 10, will show clearly what he meant about *simplex*, whilst the present writer's fig. 1, G, will illustrate what he meant about the European species—it being prepared from a photograph of a preparation of the third antennal segment of *vitripennis* ♀, in which the arista has been deliberately floated back in the mounting medium. In its normal position it would extend more or less parallel to the long axis of the antenna and thus create an illusion of being sub-apical, or even apical from a different angle where the point of insertion was concealed on the opposite side of the third antennal segment. In the male of *orientalis* (fig. 1, F) the insertion is not strictly apical although Schmitz refrained from specifically mentioning the fact, but oddly enough in the female it is apical, in the present writer's view. The range from *Conicera* through *Gymnoptera* to *Citrago* (fig. 1, D-I) now seems to make the character of the insertion of the arista of much less generic and specific value, particularly in view of the possibilities of differing interpretations. I consider, therefore, the generic name *Parafannia* Bohart, 1947, must sink as a synonym of *Gymnoptera* Lioy, 1864.

Now, as regards the species *molluscovora* (philologically more correctly *molluscivora*), it will be seen from the illustrations (fig. 2, F-J) of the female wings of *Gymnoptera*, that it has many affinities with the other two tropical species, *orientalis* and *simplex*; and it is interesting to note that the known biology of *molluscovora* and *orientalis* shows them to be saprophagous—giving further point to Schmitz' comment of *simplex*, "wahrscheinlich Aasfresser." In general facies the wings of the five species seem to separate themselves into two groups consisting of the three tropical species on the one hand and

the two European on the other. Micrometric measurements, however, from the material before me yielded the following results:

| ♀ | Index length to width | Costal index | Segment Ratios | Index 2 to 1 |
|---|---|---|---|---|
| *orientalis* | 2.12 | 0.49 | 26:33 | 1.27 |
| *molluscovora* | 2.23 | 0.54 | 24:31 | 1.29 |
| *simplex* | 2.25 | 0.55 | 22:30 | 1.44 |
| *vitripennis* | 2.26 | 0.52 | 21:30 | 1.34 |
| *longicostalis* | 2.42 | 0.59 | 25:41 | 1.64 |

For the first column the length was taken as indicated for arriving at the costal index by Schmitz (1938, textfigs. 44, 45), and the width as from the apex of the costa to a point on the hind margin ascertained by a perpendicular from the line of the costa. All other measurements taken as for the standard method of Schmitz. It will be noticed that for the two European species the figures in columns 2 and 3 show small variations from those of Schmitz (1952). This may well be due to the fact that Schmitz' figures are nearly all condensed into single-figure approximations for the particular purpose of his work and partly also, no doubt, to bias arising from the limited amount of material examined, individual variation having been noticed. Nevertheless, the table may prove to be of some corroborative diagnostic value if used in conjunction with the figures, which themselves will be subject to some divergence from the table arising from the small inaccuracies inseparable from the process of preparing and reproducing line illustrations from photographs. In order to obtain as much accuracy in the figures as possible, the method of inking in with waterproof ink on photographic enlargements was employed, the photographs being subsequently bleached out and the resulting line figures reduced in reproduction.

A study of the male wings (fig. 2, B-E) is interesting in its demonstration of the affinities with *Conicera* (fig. 2, A). Generally speaking, the male wings seem to be shorter and wider relative to those of the females, and there is a similarity in general facies in the figures between *orientalis*, *simplex*, and *longicostalis* (fig. 2, B-D); while *vitripennis* (fig. 2, E) looks somewhat different owing to the width at the basal end being relatively less. Comparison of the figure of *longicostalis* (fig. 2, C), however, with Schmitz' figure (1952, Taf. VII, 82) shows that Schmitz' specimen was less wide relatively at the basal end. Possibly the reverse may also obtain in some specimens of *vitripennis*, but owing to the limited amount of material on hand the point cannot be checked. Micrometric measurements of the material available yielded the following:

| ♂ | Index length to width | Costal index | Segment Ratios | Index 2 to 1 |
|---|---|---|---|---|
| *orientalis* | 1.98 | 0.43–0.44 | 22:16 | 0.73 |
| *molluscovora* | ... | ..... | .... | .. |
| *simplex* | 2.00 | 0.46–0.47 | 29:21 | 0.72 |
| *vitripennis* | 2.04 | 0.45–0.46 | 42:27 | 0.64 |
| *longicostalis* | 2.00 | 0.47–0.48 | 24:22 | 0.92 |

It will be interesting to see just how the male of *molluscovora* will fit into the pattern when it is discovered.

## Summary

1. A new species of *Conicera*, indigenous to Hawaii, is discussed, together with its synonymy and that of *C. dauci* (Meigen).
2. *Conicera hawaiiensis*, n. sp., is described.
3. The larval and adult forms of *Parafannia molluscovora* Bohart are discussed and the generic name *Parafannia* Bohart, 1947, shown to be a synonym of *Gymnoptera* Lioy, 1864.
4. *Gymnoptera molluscovora* (Bohart) is confirmed as a good species and compared with the remaining known species of the genus.

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# Chrysomelidae of Samoa (Coleoptera)[1]

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(*Presented at the meeting of November 13, 1956*)

In the series INSECTS OF SAMOA, Maulik in 1929 reported upon the Chrysomelidae then in the British Museum (Natural History) and the Bishop Museum. He enumerated 17 species, of which 11 were described as new. Four of the new species were made the types of new genera. Since that time, additional material has accumulated at Bishop Museum, and this forms the basis for this paper. Five new species and two new subspecies are here described. All of them appear to be endemic. Because of the comprehensiveness of Maulik's paper, the previously known species are not redescribed. Also, because the synonymy and distribution of most of the non-endemic genera, as well as the synonymy of most non-endemic species, have been treated in Bryant and Gressitt (PACIFIC SCIENCE, 11:2-91, 1957) and Gressitt (INSECTS OF MICRONESIA 17(1), 1955), these are not repeated here.

The chrysomelid fauna of Samoa is interesting from several standpoints. It seems to represent the easternmost extension of the family into the Pacific islands. This family is not well represented on oceanic islands (Gressitt, SYSTEMATIC ZOOLOGY 5:12–32, 47, 1956). Nevertheless, the 24 Samoa species represent a sizeable sample for the eastern limit. It compares with the 137 Fiji species and the 38 Micronesian species. Three of the Samoan species are definitely introduced, and two others occur also in Fiji (one of these latter also in Tonga). Three of the genera described by Maulik as endemic to Samoa and another described by Weise have since been found in Fiji, leaving one endemic for the present, and this is here tentatively reduced to subgeneric standing. The proportional subfamily representation is similar to that in Fiji, except that there is no cassidine in Fiji. The Samoan species, however, is introduced. The genus *Brontispa*, of which a new species is here described, has not been found in Fiji. The general zoogeographical relationship of the Samoa Chrysomelidae may be stated as being an impoverished extension of the Fiji fauna, with a few species without congeners in Fiji. These latter species have their closest relatives in Micronesia and the New

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Guinea area, as far as can be determined at present. Of the 19 endemic species, 2 have their closest relatives in Micronesia. The rest presumably have their closest relatives in Fiji, but in certain genera, e.g., *Stygnobia*, the Samoa species are all very distinct from the Fiji species, and the descendants of their common ancestor, if the taxonomy is correct, may have been lost in the past or exist on islands further to the west.

This paper is based on the study of nearly 3,000 specimens of Chrysomelidae from Samoa. The bulk of the unreported material was taken by E. C. Zimmerman in 1938 and 1940, and O. H. Swezey in 1940. Smaller numbers were taken by J. F. Illingworth in 1921, D. T. Fullaway in 1930, Wray Harris in 1937, E. J. Ford, Jr. in 1942, J. L. Gressitt in 1952, C. P. Hoyt in 1953–1954, and N. L. H. Krauss in 1955.

In the enumeration of specimens, the following abbreviations are used: BISHOP (Bishop Museum), BM (British Museum, Natual History), US (United States National Museum), CAS (California Academy of Science), and CSIRO (Commonwealth Scientific and Industrial Research Organization, Canberra). All specimens are deposited in the Bishop Museum unless otherwise indicated.

The *Brontispa* drawings were prepared by Dorothy Rainwater, with the genitalic drawings by myself.

## Key to the Chrysomelidae of Samoa

1. Head normal, with vertex not projecting, and with mouth directed forward or somewhat downward ..... 2
   Head with vertex projecting strongly forward and mouth directed posteriorly below; mouth sometimes partly hidden by prosternum ..... 22
2(1). Antennae not closely inserted on front of head, separated by frons or vertex; elytra generally somewhat rigid ..... 3
   Antennae closely inserted on front of head; elytra often not rigid ..... 16
3(2). Middle three abdominal segments constricted in central portions; form of body subcylindrical (Cryptocephalinae) ..... 4
   Middle three abdominal segments not constricted; form of body more or less ovate or rounded ..... 8
4(3). Eyes touching above; antenna less than one-half as long as body; pronotum deeply punctured ..... 5
   Eyes not touching above; antenna more than one-half as long as body; pronotum not deeply punctured ..... 6
5(4). Dorsum with many minute hairs; elytron distinctly greenish .. ..... **Pycnophthalma tutuilana tutuilana** Maulik
   Dorsum glabrous; elytron bluish with bronzy tint ..... **Pycnophthalma tutuilana upoluana,** n. subsp.

6(4). Elytron even, not corrugated; length more than 2 mm. . . . . 7
Elytron not even, distinctly corrugated; length less than 1.6 mm. . . . . **Ditropidus corrugatus,** n. sp.
7(6). Pronotal punctures very feeble; elytron dark; Upolu. . . . . **Ditropidus lucidus lucidus** (Maulik)
Pronotal punctures distinct; elytron often pale on central portion of disc; Tutuila. **Ditropidus lucidus subpallidus,** n. subsp.
8(3). Wing venation not reduced; cubital veins present; clypeus not divided into two parts; body subspherical (Eumolpinae). . . . . 9
Wing venation greatly reduced: cubital veins lacking; clypeus divided into two parts; body subrounded and compressed (Chrysomelinae); reddish to pitchy with reddish pronotum . . . . . **Plagiodera samoana** Maulik
9(8). Prothorax nearly as broad or as broad as elytra, distinctly margined at side. . . . . 10
Prothorax much narrower than elytra, feebly margined at side; body strongly tapered posteriorly; elytron punctured in distinct rows; black, in part tinged with reddish. . . . . **Stethotes rufonigra** Maulik
10(9). Prothorax slightly narrower than elytra; dorsum generally glabrous; length generally more than 5 mm. . . . . 11
Prothorax as broad as elytra; dorsum densely pubescent. . . . . 12
11(10). Dorsum glabrous, green tinged with golden and reddish; elytron punctured in regular rows. . **Rhyparida aureovirida,** n. sp.
Dorsum pubescent, pale brown with greenish tinge on pronotum; elytron irregularly punctured. . . . . **Rhyparida subaeneicollis** Fairmaire
12(10). Elytral punctures entirely irregular; pronotum not completely vermiculate. . . . . 13
Elytral punctures partly in rows; pronotum completely vermiculate. . . . . **Stygnobia vermiculicollis,** n. sp.
13(12). Pronotum partly reticulate and rugose; or very coarsely punctured and body length less than 2.8 mm. . . . . 14
Pronotum finely and distinctly punctured; body length more than 3 mm. . . . . 15
14(13). Pronotum and elytron with slightly uneven contour, and with irregular areas of pubescence; length over 6 mm. . . . . **Stygnobia aenescens** Maulik
Pronotum and elytron even, evenly pubescent; length less than 2.8 mm. . . . . **Stygnobia minuta** Maulik
15(13). Apex of pronotum not much narrower than base; body length 5–6 mm.; pale to reddish brown. . . . . **Stygnobia cauta** Weise
Apex of pronotum much narrower than base; body length 3–4

mm.; color varies from brown to nearly black. . . . . **Stygnobia variabilis** Maulik

16(2). Posterior femur not greatly enlarged; femoral organ lacking; anterior coxa conical apically (Galerucinae). . . . . 17

Posterior femur greatly enlarged for jumping, and having an endo-skeletal organ; anterior coxa not conical apically (Alticinae). . . . . 20

17(16). Elytron smooth, without ridges. . . . . 18

Elytron strongly carinate; body pale reddish brown. . . . . **Plesistia brunnea** Maulik

18(17). Elytron black or partly marked with black. . . . . 19

Elytron entirely reddish testaceous. **Aulacophora similis** (Olivier)

19(18). Elytron with a large basal and a large preapical mark of black; pronotum pale; antenna pale. . . . . **Aulacophora quadrimaculata** (F.)

Elytron entirely black; pronotum pale brown to pitchy; antenna dull. . . . . **Aulacophora nigrobrunnea** Maulik

20(16). Hind tibia without a strong projection beyond tarsal insertion. . . 21

Hind tibia with a strong, acute projection beyond tarsal insertion; body nearly round in outline; black to reddish brown . . . . . **Sphaerophyma insularum** Maulik

21(20). Posterior tibia depressed at apex, which is divided into two very short lobes, each usually ending in a short spinule; reddish testaceous, feebly punctured. **Aphthona samoana,** n. sp.

Posterior tibia not depressed at apex, which is rounded and furnished with a small spinule placed in middle of terminal border; black, deeply punctured. . . . **Nesohaltica nigra** Maulik

22(1). Pronotum and elytra without broad expansions, often spined (not so in Samoan forms); head not covered by pronotum (Hispinae). . . . . 23

Pronotum and elytra with broad marginal expansions, the former often covering head (Cassidinae); reddish ochraceous, often intricately marked with black on sides of elytral disc. . . . . **Cassida strigula** Montrouzier

23(22). Prothorax squarish, not constricted near apex and base; entirely dark bluish. . . . . **Brontispa balakae,** n. sp.

Prothorax distinctly constricted near apex and base; reddish testaceous with posterior two-thirds of elytra metallic greenish blue. . . . . **Promecotheca caeruleipennis** Blanchard

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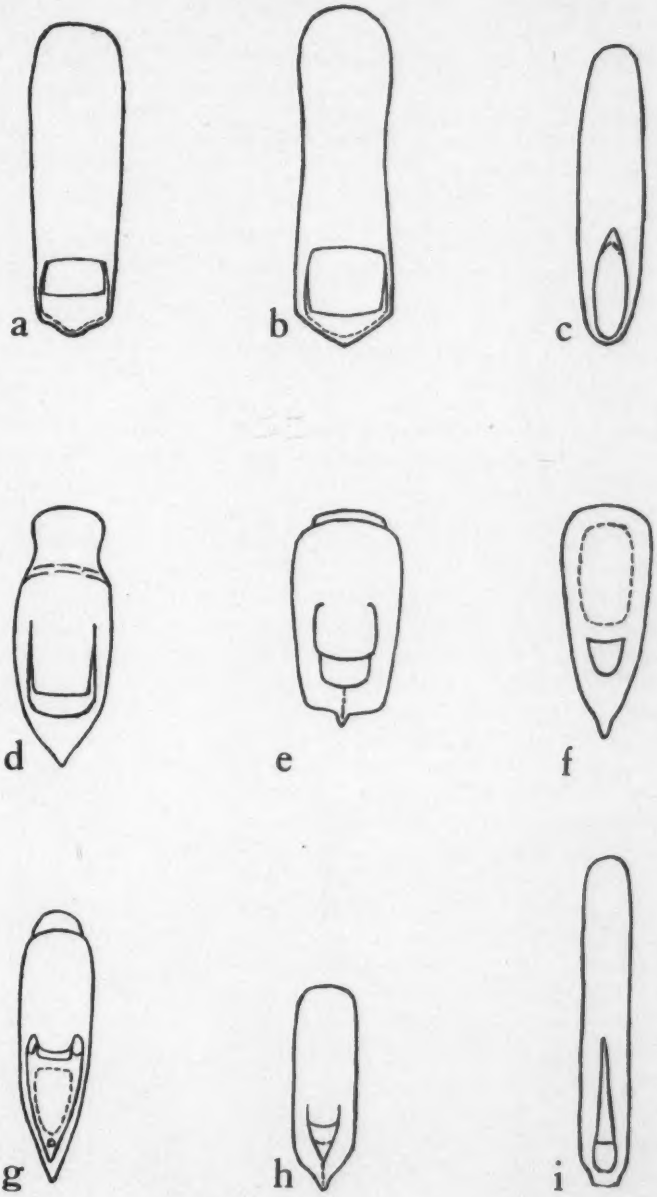
FIG. 1. Dorsal views of aedeagus. a, *Ditropidus lucidus lucidus* (Maulik). b, *D. lucidus subpallidus*, n. subsp. c, *D. corrugatus*, n. sp. d, *Rhyparida aureovirida*, n. sp. e, *Stygnobia aenescens* Maulik. f, *S. vermiculicollis*, n. sp. g, *S. cauta* Weise. h, *S. variabilis* Maulik. i, *Aphthona samoana*, n. sp.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CRYPTOCEPHALINAE

**Ditropidus (Aprionota) lucidus lucidus** (Maulik), new combination (fig. 1, a)

*Aprionota lucida* Maulik, 1929, INS. SAMOA 4(3):179, fig. 1 (type from Upolu, in British Museum).

The additional material at hand of this and related species suggests that *Aprionota* should be relegated to subgeneric status.

UPOLU:—Ten, Afiamalu, 650 meters, sweeping and beating, June 22–July 5, 1940, Zimmerman; one, near Tapatapao (Mt. Tafatafao?), 300 meters, beating, July 13, 1940, Swezey.

This species was described from nine specimens, eight of which were from Upolu. The ninth specimen, from Tutuila, is here assigned to the following new subspecies.

**Ditropidus (Aprionota) lucidus subpallidus,** new subspecies (fig. 1, b)

*Aprionota lucida* Maulik, 1929, INS. SAMOA 4(3):179 (part, Tutuila).

Female: Reddish castaneous, in part testaceous or piceous; head reddish brown, testaceous on labrum; antenna testaceous on first two segments, reddish brown to pitchy on remainder; pronotum castaneous, slightly pitchy at side; elytron castaneous, with central portion of disc testaceous and translucent or transparent; ventral surfaces reddish brown, partly pitchy on abdominal sterna. Body glabrous above, sparsely to moderately hairy beneath and on appendages.

Head with frons sparsely and deeply punctured and nearly as broad as deep. Antenna slightly more than one-half as long as body; scape nearly as long as next three segments combined; sixth longer than fifth and subequal to each of following. Pronotum practically as broad as elytra, finely and sparsely punctured, smooth, shiny, and evenly convex. Scutellum with visible portion smooth, barely longer than broad, rounded behind. Elytron smooth, feebly grooved except at side. Ventral surfaces irregularly punctured; last sternite very deeply concave along middle. Length 2.3 mm.; breadth 1.45 mm.

Male: Coloration similar; last sternite plain. Length 2.1 mm.; breadth 1.3 mm.

Paratypes: Color varying from dark pitchy brown to slightly paler than holotype; two paler than types and six darker. Length 2.1–2.9 mm.; breadth 1.2–1.5 mm.

TUTUILA:—Holotype female and allotype male (Bishop 2540), north side Pago Pago, 360 meters, beating dead branches, Aug. 8, 1940, Zimmerman. Eight paratypes: one paratopotype, same data as types; five (BISHOP, CSIRO, CAS US, BM), Fangatogo (Fagatoga?) 270 meters, beating shrub-

bery, Aug. 25, 1940, Zimmerman; one, Amanave, 120 meters, beating, Aug. 7, 1940, Zimmerman; one, Tutuila, 250 meters, Aug. 8, 1930, H. C. Kellers (paratype of the nominate form). SAVAII:—A questionable specimen from Sili, Feb., 1955, Krauss.

Differs from the nominate form in being more closely and distinctly punctured, particularly on frons and pronotum; in being less constricted at middle of side of elytron; and in being paler, as a rule.

**Ditropidus (Aprionota) corrugatus,** new species (fig. 1, c)

Male: Reddish castaneous, in part much paler or darker; head testaceous, slightly darker on parts of frons; antenna testaceous basally, piceous brown distally; pronotum castaneous, rather dark on sides of disc; elytron slightly paler castaneous; ventral surfaces castaneous, testaceous on last abdominal sternite; legs testaceous, ochraceous on femora. Body glabrous above, moderately clothed with shortish pale hairs beneath and on appendages.

Head sparsely and finely punctured, and feebly wrinkled, on frons; eyes touching above. Antenna four-fifths as long as body, moderately thickened in distal half; third to fifth segments long and slender; fourth slightly longer than third and shorter than fifth. Pronotum nearly as broad as elytra, sparsely and finely punctured, obliquely depressed at middle of side, strongly and angulately produced posteriorly over scutellum, the lobe strongly convex. Elytron slightly constricted at middle, distinctly emarginate on border; disc with ten deeply impressed grooves with distinct punctures; the punctures mostly narrow, and larger at side. Ventral surfaces irregularly punctured, largely impunctate on inner portion of metasternum and on side of first abdominal sternite; last sternite finely and closely punctured. Legs short, stout, feebly punctured. Length 1.65 mm.; breadth 1 mm.

UPOLU:—Holotype male (Bishop 2541), Malololelei road, 500 meters, beating shrubbery, July 8, 1940, Zimmerman.

This species differs from *D.* (*A.*) *lucidus* (Maulik) in being smaller; less broadened at humeri; less constricted in middle of elytron; the pronotum more narrowed anteriorly, impressed at side, and much more distinctly punctured; and the elytra more heavily punctured and distinctly corrugated. The antenna of *corrugatus* is similar in structure to that of *lucidus* but is longer.

**Pycnophthalma tutuilana tutuilana** Maulik

*Pycnophthalma tutuilana* Maulik, 1929, INS. SAMOA 4(3):181, fig. 2 (Tutuila; type in Bishop Museum).

This species is bronzy brown with the prothorax greenish bronzy and closely punctulate, and the legs pale. Length 1.9–2.1 mm.; breadth 1.2–1.4 mm.

TUTUILA:—This species was described from the unique type (Bishop 485) from Pago Pago. Eight specimens, Fangatogo (Fagatoga?), Aug. 25, 1940, beating shrubbery, Zimmerman; two, Malaeloa, May, 1954, Hoyt.

**Pycnophthalma tutuilana upoluana**, new subspecies

Female: Reddish brown, moderately tinged with bronzy; antenna pale ochraceous, very slightly duller distally; legs reddish ochraceous, paler distally; head reddish brown, darker on vertex and clypeus; pronotum dark reddish brown with bronzy and gray-blue reflections suggesting pruinosity; elytron reddish brown with bluish reflections suggesting pruinosity; ventral surfaces reddish brown. Body nearly glabrous above and with sparse, short, pale hairs beneath and on distal portions of antenna.

Head sparsely but distinctly punctured on frons. Antenna less than one-half as long as body; third to fifth segments moderately slender and subequal in length; following much stouter. Prothorax evenly narrowed distally, with moderately dense punctures. Scutellum narrow, elliptical, depressed. Elytron with 10 grooved rows of punctures, sixth row deeply grooved basally, seventh row not grooved, but with large punctures basally. Ventral surfaces subcoarsely punctured. Pygidium more finely punctured. Length 2.1 mm.; breadth 1.3 mm.

UPOLU:—Holotype female (Bishop 2542), Afiamalu, 630 meters, beating, July 3, 1940, Zimmerman.

Differs from the nominate form from Tutuila in being less metallic above and more glabrous; with darker legs, rougher frons, stouter antenna, less closely punctured pronotum, and less deeply grooved and less strongly punctured elytron.

EUMOLPINAE

**Rhyparida aureovirida**, new species (fig. 1, d)

Male: Reddish brown, largely metallic golden green above; head reddish brown tinged with bronzy green; antenna reddish basally and pitchy distally, with apices of segments mostly reddish brown; pronotum shiny castaneous in some lights and largely golden green in others; scutellum bronzy purplish brown; elytron golden green, changing to bronzy reddish brown in some lights; ventral surfaces bright reddish brown; legs reddish with tarsi and distal portions of tibiae shiny blackish. Body glabrous above, very sparsely pubescent beneath; last five antennal segments with close, short, pale pubescence.

Head narrower than apex of prothorax; frons moderately punctured and slightly rugose; occiput more sparsely punctured, smoother, but with a pair of adjacent low swellings near center. Antenna slightly more than one-half as long as body, moderately slender, slightly compressed; scape slightly shorter than next two segments combined; second a little shorter than third; third

to fifth subequal; sixth shorter; seventh stouter, longer than scape, subequal to remaining. Pronotum one-half again as broad as long, much narrower than elytra, suboblong, but slightly convex on each border, slightly narrower at apex than at base; disc smooth and even, finely and sparsely punctured, nearly flat above in lateral view. Scutellum scutiform, with only a few minute punctures. Elytron more than three times as long as pronotum, gradually narrowed posteriorly, convex in lateral view; disc with 11 distinct rows of moderate punctures including scutellar row, the rows becoming somewhat confused in apical third; the punctures mostly smaller than longitudinal interspaces. Ventral surfaces shiny, very sparsely and finely punctured. Legs shiny; femora strongly swollen. Aedeagus bent downward to nearly a right angle before apex, subevenly narrowed to tip. Length 7.75 mm.; breadth 4.25 mm.

TUTUILA:—Holotype male (Bishop 2543), Mt. Pioa, 550 meters, beating shrubbery, Aug. 29, 1940, Zimmerman.

Differs from *R. subaeneicollis* Fairmaire in being nearly twice as large, and in having the elytra more greenish than pronotum and punctured in regular rows instead of irregularly punctured.

**Rhyparida subaeneicollis** Fairmaire

*Rhyparida subaeneicollis* Fairmaire, 1879, LE NATURALISTE 1:76 (Samoa, type in Paris Museum?); 1881, ANN. SOC. ENT. FRANCE (6)1:484; Maulik; 1929, INS. SAMOA 4(3):190.

No specimens have been seen, as was likewise reported by Maulik.

**Stygnobia aenescens** Maulik (fig. 1, e)

*Stygnobia aenescens* Maulik, 1929, INS. SAMOA 4(3):182, fig. 3 (Tutuila; type in Bishop Museum).

TUTUILA:—Seventy-nine specimens. Fangatonga (Fagatoga?) Reservoir, Aug. 2, 1938, Zimmerman; Matafau (Matafao?) trail, Aug., 1940, Zimmerman; Amouli, Moloata, north side Pago Pago, Aug., 1940, Zimmerman; Moloata, May, 1954, Hoyt; Avau, Amouli, Fagasa, Pago Pago (Bryan, Kellers, Judd, Swezey and Wilder; reported by Maulik).

**Stygnobia vermiculicollis,** new species (fig. 1, f)

Male: Reddish brown, varying to pitchy, clothed with golden to whitish pubescence; head reddish, pitchy black on median portion of frons, vertex, and occiput; antenna ochraceous, slightly duller on parts of postmedian segments; pronotum reddish brown; elytron reddish brown, in part vaguely darker; ventral surfaces reddish brown, slightly pitchy on side of metasternum; legs pale reddish brown with bases and apices of femora blackish. Body moderately clothed above with golden pubescence, in part somewhat whitish; ventral surfaces more sparsely and less evenly clothed.

Head about as broad as apex of prothorax, rather broad and flat between eyes and antennal insertions, punctures vermiculate-reticulate. Antenna slender, nearly as long as body; scape not quite as long as next two segments together; second two-thirds as long as third; fourth slightly longer than second and third combined; fifth equal to fourth, longer than sixth; sixth to last subequal. Pronotum two-thirds as long as broad, slightly narrower at apex than at base, feebly convex on side and apex, sinuate at base with middle of base convex; disc convex, slightly irregular, densely vermiculate. Scutellum about as broad as long, slightly narrowed and rounded apically, densely punctured. Elytron more than two and one-half times as long as pronotum; disc uneven, with some partial ridges and punctures of two sizes, the small punctures very dense and irregular, the larger punctures partly in vague longitudinal lines. Ventral surfaces sparsely and shallowly, or finely punctured. Legs shiny, moderately punctured. Aedeagus narrow, tapered and acuminate apically. Length 6 mm.; breadth 3.1 mm.

UPOLU:—Holotype male (Bishop 2544), Afiamalu, 630 meters, beating shrubbery, June 13, 1940, Zimmerman. Three paratypes, males, one (CAS) same data as type, the other two Malololelei road, 550 meters, beating shrubbery, July 8, 1940, Zimmerman.

Differs from *C. aenescens* Maulik in having the dorsum reddish instead of bronzy; the pronotum more even in contour, though duller, and more completely vermiculate, without distinct punctures; the elytron more even in general contour, but with rougher, duller surface, and with two distinct types of punctures, the larger ones in partial rows; and the aedeagus more slender and more gradually narrowed at apex.

**Stygnobia cauta** Weise (fig. 1, g)

*Stygnobia cauta* Weise, 1922, ARCHIV. FÜR NATURGESCH. 88(A)10:154 (Samoa; type in Deutsche Entomologische Museum); Maulik, 1929, INS. SAMOA 4(3):184, fig. 4.

*Stygnobia annulipes* Weise, 1922, ARCHIV FÜR NATURGESCH. 88(A)10:154 (Samoa; type in Deutsche Entomologische Museum).

Two hundred and thirty-four specimens in Bishop Museum. SAVAII:—Fagamalo (Buxton and Hopkins; reported by Maulik), Palauli, Sili, Feb., 1955, Krauss. UPOLU:—Afiamalu, July, 1940, Swezey; Tapatapao (Mt. Tafatafao?), July, 1940, Zimmerman; Malololelei road, July, 1940, Zimmerman; Apia, Mafa Pass road, Feb., 1955, Krauss; Aleipata, Lalomanu, Leulumoega, Mulifanua (Buxton and Hopkins, Armstrong, Swezey and Wilder; reported by Maulik). TUTUILA:—Aua-Afono, Vailoa, Tuaulu, Taputimu, Amouli, Leone-Aule, Leone-Aluau, Aua-Afono, Feb.–Mar., 1930, Fullaway; Breaker Point, Blunt's Point, Aug., 1940, on *Hibiscus tiliaceus* L., Swezey;

Amouli, Amanave, Matafao trail, Aug., 1940, Zimmerman; Taputimu, Aua, Sept.-Nov., 1953, Hoyt; Pago Pago, Leone road, etc. (Kellers, Swezey and Wilder, Bryan; reported by Maulik). MANUA:—Tau (Swezey and Wilder; reported by Maulik).

**Stygnobia variabilis** Maulik

*Stygnobia variabilis* Maulik, 1929, INS. SAMOA 4(3):186, fig. 5 (Upolu, Tutuila, Savaii; type from Upolu in British Museum).

There is extreme variation in the dorsal puncturation, particularly of the pronotum. The color varies from testaceous to pitchy.

Over 480 specimens in Bishop Museum. SAVAII:—Fagamalo, Salailua, Safune (Bryan; reported by Maulik); Palauli, Sili, Feb., 1955, Krauss. UPOLU:—Tapatapau (Mt. Tafatafao?), Afiamalu, Sinaele, Malololelei, June–July, 1940, Zimmerman, Swezey and Zimmerman, 200 specimens; Apia, Jan., 1952, Gressitt; Tapueleele, Mafa Pass road, Feb., 1955, Krauss; Malololelei, Leulomoega, Mt. Vaea, Vailima, Apia (Buxton and Hopkins, Armstrong, Swezey and Wilder; reported by Maulik). TUTUILA:—Fagatoga, 300 meters, beating, Aug., 1940, Zimmerman; Pago-Matafao trail, Aug., 1940, Zimmerman; Amanave, Amouli, north side Pago Pago, Mt. Pioa, Aug., 1940, Zimmerman; Utulei, Aug., 1940, Swezey; nearly 200 specimens. Various localities, including Fagasa and Pago Pago (Kellers, Swezey, Wilder and Bryan; reported by Maulik.)

**Stygnobia minuta** Maulik

*Stygnobia minuta* Maulik, 1929, INS. SAMOA 4(3):188, fig. 6 (Upolu, Tutuila; type from Upolu in British Museum).

Color varies from pale reddish brown to pitchy; elytra sometimes plain and sometimes vaguely striped.

Thirty-eight specimens in Bishop Museum. UPOLU—Malololelei road, 550 meters, Aug., 1940, Swezey and Zimmerman; Afiamalu, July, 1940, Zimmerman; 35 specimens. TUTUILA:—Only the single specimen taken by Bryan at Pago Pago and reported by Maulik.

**Stethotes rufonigra** Maulik

*Stethotes rufonigra* Maulik, 1929, INS. SAMOA 4(3):190 (Savaii; type in Bishop Museum).

This species is shiny black, tapered caudally, with elytral punctures in regular rows. Length 2.9–3.1 mm.; breadth 1.4–1.6 mm.

SAVAII:—Safune (the type, Bryan). UPOLU:—Thirteen specimens, Afiamalu, 700 meters, July 4, 1940, Zimmerman; Tiavi, 650 meters, June 21, 1940, Zimmerman.

CHRYSOMELINAE

**Plagiodera samoana** Maulik

*Plagiodera samoana* Maulik, 1929, INS. SAMOA 4(3):191, fig. 8 (type from Upolu in British Museum).

Coloration varies from orange through reddish to pitchy black with reddish pronotum.

Forty specimens in Bishop Museum. UPOLU:—Afiamalu, July, 1940, Swezey and Zimmerman; Malololelei road, July, 1940. Swezey. TUTUILA:—Fagasa trail, 250 meters, beating shrubbery, Aug., 1940. Zimmerman.

GALERUCINAE

**Aulacophora similis** (Olivier)

*Galeruca similis* Olivier, 1808, ENTOMOLOGIE 6:624, no. 93, pl. 2, fig. 23 (East Indies).

This is a common pest of cucurbits.

SAVAII:—Safune (Buxton and Hopkins; reported by Maulik). NUUTELE:—Reported by Maulik. UPOLU:—Sinaele, July, 1940, Aleisa road, Apia, June, 1940, Zimmerman; 1942, Ford; Feb., 1955, Krauss. TUTUILA:—Fagaitua, Leone-Aluau trail, Fagasa trail, Aua-Afono trail, Leone-Aule trail, Vaitogi, Feb.–Mar., 1930, Fullaway. MANUA:—Tau Island (Swezey and Wilder; recorded by Maulik). One specimen is in the collection from Niue Island, June 20, 1940, T. G. Yuncker.

**Aulacophora quadrimaculata** (F.)

*Crioceris quadrimaculata* F., 1781, SPEC. INS. 1:152 ("Cape of Good Hope"; type in British Museum).

This common four-spotted species is also a pest of cucurbits. Two hundred and twenty-five specimens in Bishop Museum. SAVAII:—Fagamalo, Salailua (Bryan; reported by Maulik); Palauli, Feb., 1955, Krauss. UPOLU:—Aleipata, Siumu, Apia (after Maulik). TUTUILA:—Aua-Afono trail, Fagaitua, Fagasa trail, Amouli, reservoir on Fagatoga trail, Vaitongi, Amouli, Feb.–Mar., 1930, Fullaway; Fagatoga, Aug., 1940, Zimmerman; Taputimu, May, 1953, Hoyt. MANUA:—Olosega Island, May, 1930, Fullaway; Tau Island (Judd, Swezey and Wilder; reported by Maulik).

**Aulacophora nigrobrunnea** Maulik

*Aulacophora nigrobrunnea* Maulik, 1929, INS. SAMOA 4(3):196, fig. 9 (type from Upolu in British Museum).

This endemic species does not seem to have been associated with crops.

Fifty-one specimens in Bishop Museum. SAVAII:—Safune (Bryan; reported by Maulik). UPOLU:—Afiamalu, June, 1940, at light and beating, Zimmerman; Malololelei road, 600 meters, June, 1940, Swezey. TUTUILA:—Fagasa trail, Maupasaga, Aua-Aponota trail, Feb.–Mar., 1930, Fullaway.

**Plesistia brunnea** Maulik

*Plesistia brunnea* Maulik, 1929, INS. SAMOA 4(3):199, figs. 10, 11 (type from Upolu in British Museum); Bryant and Gressitt, 1957, PAC. SCI., 11:67.

This elongate brown species is the only one in this genus. It has since been found in Fiji.

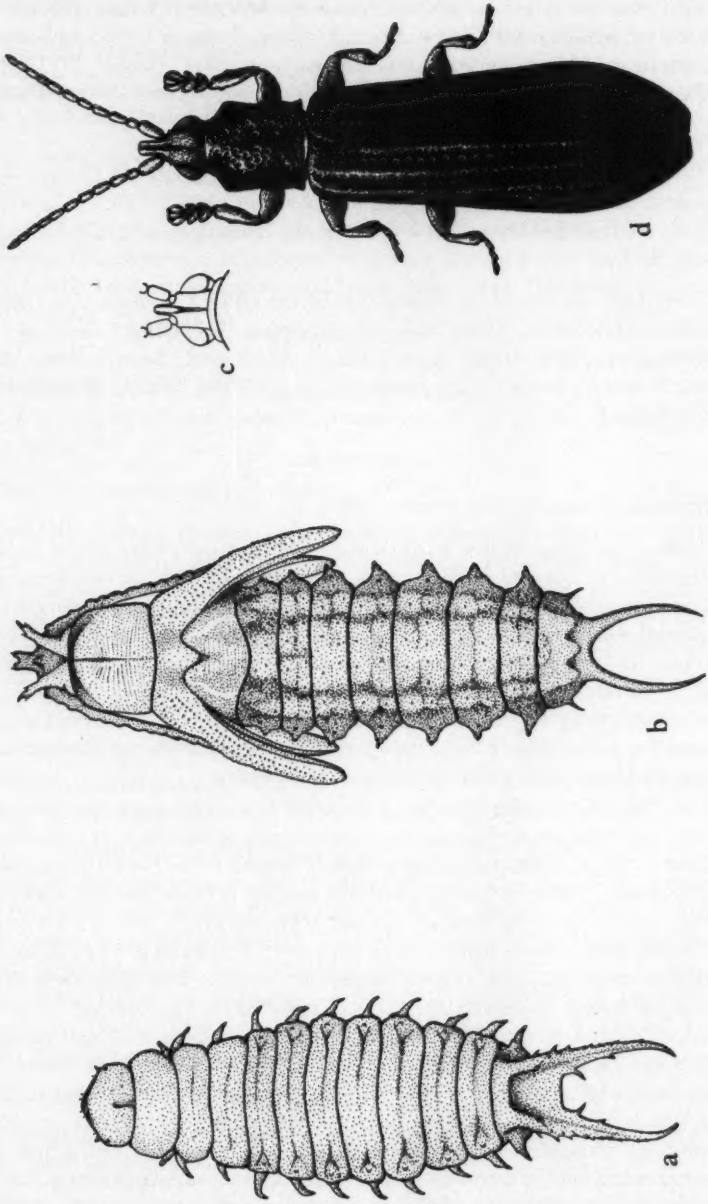
Forty-four specimens in Bishop Museum. UPOLU:—Apia, on *Hibiscus tiliaceus*, Malololelei, June, 1940, Zimmerman. TUTUILA:—reservoir on Fagatoga trail, Aua-Afono, Aunuu Island, Afone trail, Amouli, Feb.–Mar., 1930, Fullaway; Blunt's Point, sweeping, Aug., 1940, Swezey; Tafuna, Jan., 1952, Gressitt.

ALTICINAE

**Aphthona samoana,** new species (fig. 1, i)

Male: Testaceous brown, marked with pitchy in part; head pitchy brown, paler on frons; antenna pitchy brown, ochraceous on first two segments and reddish brown on next two; pronotum pale testaceous brown, subtransparent, appearing more reddish on areas of muscle insertion; scutellum reddish ochraceous, translucent; elytron orange testaceous, slightly piceous along suture; ventral surfaces ochraceous; legs ochraceous, reddish brown on tarsi and hind tibia, pitchy on distal two-thirds of hind femur. Body glabrous above, except for a few minute hairs on apical margin of elytron; ventral surfaces and appendages with short, sparse, pale pubescence.

Head slightly broader than long, as broad as apex of prothorax, medially convex and micropunctulate on frons, with a pair of small adjacent swellings behind antennal insertions; occiput slightly wrinkled and bordered anteriorly by an obtuse groove. Antenna four-fifths as long as body, slightly thickened distally; scape nearly as long as next two segments combined; second nearly as long as third; fourth barely longer than third; fourth to seventh subequal; eighth to tenth each very slightly longer; last longest. Pronotum three-fifths as long as broad, transverse apically, convex basally, but truncate in central portion of basal margin; side convex, but nearly straight in central portion, with a small angle one-fourth from apex and a feeble obtuse angle one-fourth from basal angle; disc evenly convex, with irregular feeble punctures. Scutellum triangular, micropunctulate. Elytron evenly rounded externally, broadest at middle, rounded at apex; disc very finely and irregularly punctured, the punctures apparently absent on basal quarter. Ventral surfaces sparsely, finely, and irregularly punctured. Aedeagus narrow, with apex suddenly slightly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narrowed and broadly truncate, with rounded corners. Legs stout; hind femur nearly two-fifths as broad as long; first hind tarsal segment nearly as long as remainder combined. Length 2 mm.; breadth 1.1 mm.

Female: Last abdominal sternite plain, ungrooved. Length 2 mm.; breadth 1.05 mm.

UPOLU:—Holotype male and allotype female (Bishop 2545), Tapatapao (Mt. Tafatafao?), 300 meters, sweeping Bermuda grass; July 17, 1940, Swezey; one paratopotype female, sweeping, July 24, 1940, Swezey.

Differs from *A. nanyoensis* Chujo, of Micronesia, in being less reddish; much less distinctly and less completely punctured on elytron; and in having the aedeagus more broadly truncate apically.

**Nesohaltica nigra** Maulik

*Nesohaltica nigra* Maulik, 1929, INS. SAMOA 4(3):201, fig. 12 (type from Upolu in British Museum).

This is the type species of the genus. Three additional species have been described from Fiji.

Sixty-six specimens in Bishop Museum. SAVAII:—Salailua (Bryan; reported by Maulik); Patamea, Sili, Feb., 1955, Krauss. UPOLU:—Afiamalu, 650 meters, June, 1940, Zimmerman; Lanutao, 700 meters, Sinaele, July, 1940, Zimmerman; Mafa Pass road, Feb., 1955, Krauss; Mt. Vaea, Vailima, Malololelei, Tuaefu (reported by Maulik). TUTUILA:—North side of Pago Pago, Pago-Matafao trail, Amouli, 150 meters, Aug., 1940, Zimmerman.

**Sphaerophyma insularum** Maulik

*Sphaerophyma insularum* Maulik, 1929, INS. SAMOA 4(3):202, figs. 13, 15*k* (type from Tutuila in Bishop Museum, incorrectly indicated as in British Museum in original description).

This species was described from two specimens from Tutuila.

There are now three specimens in Bishop Museum, with two new island records. UPOLU:—Afiamalu, 650 meters, sweeping, July 2, 1940, Zimmerman, one specimen. TUTUILA:—Aunuu Island, Feb., 1930, Fullaway. The type is from Pago Pago, the paratype (British Museum) from Leone road.

HISPINAE

**Brontispa balakae,** new species (fig. 2)

Male: Body reddish castaneous, darker on pronotum and paler on femora; antenna reddish on scape and last segment, pitchy to black on remainder;

FIG. 2. *Brontispa balakae*, n. sp. a, dorsal view of mature larva. b, dorsal view of pupa. c, dorsal outline of head of allotype female. d, dorsal view of holotype male.

elytron slightly iridescent blue, becoming brownish toward apex, and black along suture and extreme basal margin. Frons densely pale pubescent, almost resembling tarsal pads.

Head nearly one-half as long as prothorax, wider at eyes than at neck; occiput slightly broader than long, deeply grooved medially, finely punctured; cephalic process oblong, nearly as long as scape, almost one-half as broad as long, broadly grooved medially, continuous with occipital groove, leaving a narrow ridge on each side above, smooth and slightly concave beneath; frons finely punctured, with erect pubescence; postocciput impunctate. Antenna slightly longer than head and prothorax combined, slightly flattened distally; scape nearly twice as long as pedicel; third segment one-half again as long as pedicel, subequal to each of next three; seventh slightly longer, equal in length to last; eighth to tenth slightly shorter, not narrowed basally like third to sixth; last four pubescent at sides. Prothorax as broad as long, almost straight at side, slightly broader anteriorly than posteriorly; anterior angle without tooth, somewhat evenly convex; anterior margin strongly convex; basal angle distinct, without indentation; disc uneven, coarsely and irregularly punctured, largely impunctate along median line and obliquely toward anterolateral corner; side declivous to lateral margin. Scutellum about as broad as long, rounded behind. Elytron a little more than twice as long as head and prothorax combined, distinctly widened behind middle, rounded and narrowly subtruncate apically; disc regularly punctured in eight rows anteriorly and ten rows behind middle, alternate interstices broader and more strongly raised, second and fourth carinate on apical declivity; apical margin slightly expanded. Ventral surfaces largely smooth and micropunctulate, but with a few deep punctures on side of thorax. Legs relatively long and shiny; femora impunctate, hind femur reaching well beyond apex of first abdominal sternite. Length 7 mm.; breadth 2.1 mm.

Female: Interantennal process not quite one-half as long as scape, broadly grooved and blunt as in male. Length 7.1 mm.; breadth 2.2 mm.

Paratypes: Length 6.7–8 mm.; breadth 1.9–2.35 mm.

UPOLU:—Holotype male (Bishop 2507), Afiamalu, 650 meters, June 30' 1940, on *Balaka* palm, Swezey; allotype female, Malololelei road, 500 meters' on *Clinostigma* palm, Swezey; sixty-nine paratypes (BISHOP, BM, US, CSIRO, CAS): fifty-seven paratopotypes, of which 50 found on *Balaka*, mostly by Swezey, June 30, 1940, a few by Swezey and Zimmerman, June 19, 1940, and seven reared from *Clinostigma*, July 3, 1940, Swezey; three, same data as for allotype, Swezey; six, Lanutao trail, 400 meters, Tapatapao (Mt. Tafatafao?), Aug. 21, 1940, on *Balaka*, Swezey; one, near Tapatapao (Mt. Tafatafao?), 300 meters, July 13, beating dead branches, and one, Sinaele, 450 meters, July 27, 1940, Zimmerman; one, Malololelei, Feb., 1955, Krauss.

This species differs from *B. chalybeipennis* (Zacher) in being less flattened

and less parallel-sided; the cephalic process longer; the pronotum less even, less finely and less sparsely punctured; and the elytron less finely punctured, lacking a sutural row of punctures, and not emarginate apically. The lack of a scutellar puncture row is characteristic of *Octodonta* and *Uhmannia*, but they have four teeth on each side of the prothorax.

Egg: Oblong-oval, very slightly wider near anterior end, finely reticulate; reddish brown, enclosed in a frail envelope; laid on young palm fronds. Length 1.4 mm.; breadth 0.75 mm.; depth 0.35 mm.

Newly hatched larva: Arms of tail-shovel slender and nearly one-half as long as body. Length 2.6 mm.

Mature larva: Pale testaceous, slightly duller on tip of caudal furca (tail-shovel). Head transverse, subparallel-sided, obtuse anteriorly, slightly depressed behind middle, fairly smooth; prothorax obtuse laterally, feebly pigmented across central portion; mesothorax with very prominent spiracle at anterior angle, and a backward-curving, seemingly three-segmented lateral process at middle of side; metathorax similar, with similar lateral process; first abdominal segment very similar in dorsal view to metathorax, but with slightly longer lateral process; second to seventh abdominal segments each similar to first, but each with lateral process and spiracle progressively slightly longer; last abdominal segment narrower than preceding, with similar lateral process, and with tail-shovel more than one-third as long as body, each ramus somewhat evenly tapered and arched, with a subbasal strong interior tooth, a weaker submedian tooth, some small external basal teeth, and finer dorsal teeth. Length 9 mm.; breadth nearly 3 mm. including lateral processes.

The larva is quite similar to that of *B. chalybeipennis*, giving added reason for assigning this species to the genus *Brontispa*, in spite of the differing body form and lack of extra scutellar row of punctures on elytron.

Pupa: Pale testaceous; head with bilobed anterior process and a pair of tapering, downward-curved dorsal processes bearing a few small tubercles; pronotum with a few tubercles near anterior margin and anterolateral angles; mesonotum and metanotum finely ridged transversely; elytral pad with rows of fine tubercles; abdominal tergites each with about eight fine tubercles, more distinct on second to sixth segments; a small tubercle before each spiracle from second to sixth (last); second to seventh pleurites each with a broad-based, suddenly tapering, horizontal process; last segment with a small, slender, lateral process and terminating in a long, bifurcate, caudal process with arched, tapering arms. Length 10 mm.

Hosts: *Balaka rechingeriana* Burret, *Clinostigma oncorhyncha* Beccari.

A number of eggs, larvae of different ages, and pupae, including the above described immature stages, were taken at Afiamalu, Upolu, Samoa, August 8, 1940, on *Balaka* palm, by Swezey. Adults, enumerated above, were taken at the same time.

Although there is no such evidence known, it is possible that this beetle might some day attack the coconut palm in Samoa. In some other areas, such as Micronesia, the only proven host of the species of *Brontispa* is the coconut palm, yet there, also, the beetles may have been present before the coconut palm arrived. This new species is known only from the island of Upolu, but it may very likely occur on Savaii. It is quite likely absent from Tutuila and other islands of Eastern Samoa. This species represents the easternmost known record for the genus *Brontispa*. It is not a very typical member of the genus, as it is distinctly broadened posteriorly and specially sculptured on the prothorax and elytron. It is interesting to note that no native species of *Brontispa* have been found in the New Hebrides, Tonga, or Fiji, though special searching has been done in Fiji and Tonga.

**Promecotheca caeruleipennis** Blanchard

*Promecotheca caeruleipennis* Blanchard, 1853, VOY. PÔLE SUD 4(Zool.):312 (Tonga; type in Paris Museum).

*Promecotheca lindingeri* Aulmann, 1914, ENT. RUNDSCHAU 31:27 (Samoa).

*Promecotheca coeruleipennis* ab. *reichei*, Weise, 1922, PHIL. JOUR. SCI. 21(1):70.

*Promecotheca reichei*, Maulik, 1929, INS. SAMOA 4(3):210, figs. 17–18.

For additional synonymy, see Bryant and Gressitt, 1957, PACIFIC SCIENCE 11:90.

This is the once very destructive coconut hispine of Fiji. It is interesting that no additional specimens have been taken in Samoa in recent years.

UPOLU:—Mulifanua (reported by Maulik). Apia, Aug., 1933, H. W. Simmonds. TUTUILA:—Pago Pago and 300 meters altitude (reported by Maulik); "Samoa," 1921, Illingworth; Naval Station, seashore, royal palm, Aug. 5, 1940, Swezey.

CASSIDINAE

**Cassida strigula** Montrouzier

*Cassida strigula* Montrouzier, 1855, ANN. SCI. PHYS. LYON (2)7(1):67 (Woodlark Island; type in Paris Museum ?); Maulik, 1929, INS. SAMOA 4(3):214.

This tortoise beetle feeds upon sweet potato. As indicated by Maulik, this species has been called a subspecies of *C. diomma* Boisduval, from New Guinea.

Three hundred and ten specimens in Bishop Museum. SAVAII:—Patamea, Feb., 1955, Krauss. UPOLU:—Tapatapao (Mt. Tafatafao?), July, 1940, Swezey; Falepuga, July, 1940, Swezey; Toauma, Faleata Distr., 1937, Harris; Falefa, Lefaga, Tapueleele, Feb., 1955, Krauss. TUTUILA:—Many localities, nearly 300 specimens, 1918–1953, Kellers, Fullaway, Swezey, Wilder, Zimmerman, Hoyt, and others; Aunuu Island, 1930, Fullaway.

# Austromyia neglecta Hardy, a New Synonym of Neotoxura discoidalis (Bezzi) (Diptera: Pyrgotidae), with a Discussion of Some Family Relationships

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*Austromyia neglecta* was described from a series of specimens from New South Wales (Hardy, Proc. Haw. Ent. Soc. 15(2):327–330, figs. 1a–f, 1954) which I had originally considered to be an aberrant genus and species of Tephritidae, and I could not satisfactorily place it. Although obviously belonging in a borderline group the species seemed to possess more of the characteristics of the Tephritidae than of any of the related families. In the keys to the subfamilies and genera of Tephritidae it runs to the Oedaspinae and fits fairly close (in keys) to the genus *Oedaspis* Loew, although it is obviously not related to this genus nor to any of the members of this subfamily with which I am acquainted.

While studying at the British Museum (Natual History) during the summer of 1954, I had my first opportunity to examine specimens of the pyrgotid tribe Toxurini and discovered that I had been in error in my treatment of the series which I had earlier studied from Australia. About the same time, Dr. Martin Aczél, Tucumán, Argentina, wrote to me pointing out that my species was probably a synonym of *Neotoxura discoidalis* (Bezzi) (Proc. Linn. Soc. N.S. Wales 54:9, 1929). I have checked this in detail and without doubt these are the same species.

This brings up an interesting and most confusing controversy regarding the true position of various of these borderline groups. Dr. Aczél has pointed out, in correspondence, that phylogenetically the members of the Australian tribe Toxurini are very closely related to the Tephritidae. He also said he was convinced that the Australian region is the place where the families Pyrgotidae and Tephritidae have been segregating from the same ancestors. I believe also that at least some of the Otitidae of Australasia may have arisen from common ancestors with some of the Pyrgotidae and Tephritidae. The typical members of these three groups are very readily differentiated by a number of striking family characters. The atypical members show all degrees of intergradation to the extent that the family criteria seem to break down completely. Correspondingly the authorities on these various families differ greatly in their placement of the controversial groups.

The pyrgotids are treated as a subfamily of the Otitidae in the British Museum collection; most authors, however, treat them as a distinct family. Malloch (PROC. LINN. SOC. N.S. WALES 54:23, 1929) restricted the Pyrgotidae to those genera which have (1) the 2nd antennal segment entire (lacking a longitudinal dorsal cleft); (2) ocelli lacking or rudimentary; (3) middle coxae without a well-developed prong; (4) empodium without a fringe of fine hairs; and (5) the lower calypter shorter than the upper, usually rudimentary. Malloch considered the Toxurini (*Neotoxura et al.*) to belong to the family Otitidae because of the presence of ocelli, a midcoxal prong, the 2nd antennal segment cleft, the empodium fringed, and the lower calypter well developed. In *Neotoxura discoidalis* I see no evidence of a fringe on the empodium, and the otitid characters listed by Malloch are possessed by most tephritids.

In his comparison of the characters of the Tephritidae (as Trypetidae) and the Otitidae (as Ortalidae) Malloch (INS. SAMOA 6, fasc. 7:1, 1931) said: "There is a very strong resemblance between many members of this family [Tephritidae] and others belonging to the Ortalidae, but they may be separated from the latter by the bristling of the frons and pleura and less decisively by wing venation." He indicated that incurved inferior fronto-orbital bristles are always present in the Tephritidae, in Otitidae and the "orbits are frequently entirely devoid of bristles, and there are but a few cases where an anterior incurved bristle is present." The inferior fronto-orbital bristles are predominantly present in the Tephritidae, but at least in genera such as *Monacrosticus* Bezzi and *Callantra* Walker they are lacking. Malloch said the pteropleuron of the Tephritidae "always bears a quite well developed bristle or numerous strong setulae" and that he knew of no member of the Otitidae which possesses a strong bristle. The pteropleural bristle is well developed in *Neotoxura*. Malloch further stated: "where there is any doubt as to either or both of these characters the course of the subcostal vein may be taken as the criterion." Following this concept, *Neotoxura* would seem to be a fruit fly, and I still fail to find satisfactory characters for placing it in any other family. This as well as other borderline groups needs to be studied in more detail to determine whether or not the Otitidae, Pyrgotidae, and Tephritidae should be retained as distinct families or combined under one family. This statement would also pertain to the otitid subfamily Platystominae, treated as a distinct family by some workers.

Typically the tephritids can be recognized by having the subcostal vein bent upward sharply at a right angle before the apex and the cubital cell drawn out into an acute point at its lower apex. The fruit fly tribe Eribiini, however, lacks the pointed cubital cell; the otitid subfamily Ulidiinae has the cubital cell pointed; the otitid subfamily Plastotephritinae has the subcostal vein as in the Tephritidae, bent angularly at the tip; and in many of the Toxurini the subcosta is bent upward and cell Cu is sharply pointed.

# On the Mode of Dissemination of the Two-Spotted Spider Mite, Tetranychus telarius (L.) (Acarina: Tetranychidae)[1]

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In a recent paper Fleschner *et al.* (1956) review the literature on dispersal of tetranychid mites by air currents and present the results of original research on these four species: *Metatetranychus citri* (McGregor), the citrus red mite; *Oligonychus punicae* (Hirst), the avocado brown mite; *Eotetranychus sexmaculatus* (Riley), the six-spotted mite; and *Tetranychus telarius* (L.), the two-spotted spider mite.

These authors found that the first three species listed above behaved similarly in regard to dissemination by air currents. As mite populations on infested trees reached high levels or peaks, large numbers of adult females were observed to spin down from leaves and hang freely suspended in air, each by a single silken filament. The mites were then disengaged from the trees and dispersed by gentle to moderate breezes, often to heights much greater than the trees, with the silken filaments presumably acting much like parachutes and imparting considerable lift to the mites. It was noted that the main direction of mite dispersal was sometimes contrary to that of the prevailing winds. This was particularly true of the avocado brown and six-spotted mites, which were studied in an area where the gentle nocturnal breezes—in this case the dispersing currents—blew in the opposite direction of the strong diurnal winds and where spinning down of the mites occurred in the early evening when the air was relatively still. An important conclusion of the authors was that more dispersion of mites, in the case of the three species under consideration, is accomplished by gentle air currents than by strong winds as a result of the mites' habit of spinning down only during relatively calm atmospheric conditions. Moreover, wind-drift dispersal appeared to be limited to adult females.

The findings of these authors regarding the two-spotted spider mite are limited to the statement that "in no instance was this mite observed to spin down free from the leaves or to drift away from the infested plant."

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Experiments on the mode of dispersal of *telarius* were conducted in Hawaii by the present author from November 18, 1955, to June 4, 1956. Observations presented here agree with those of Fleschner *et al.* that *telarius* does not spin free of the infested plant on silken filaments, but they strongly indicate that this species is normally disseminated by wind. They also furnish good evidence that stronger wind currents are necessary to transport *telarius* than those species that spin down—perhaps because the parachute-like filament is lacking—and that wind drift is not limited to the adult female.

The species studied here agrees well with all the characters listed by Boudreaux (1956) for *T. telarius* (L.) except for the color of the adult summer female, which appears invariably to be carmine as in *cinnabarinus* (Boisduval).

Terminology used here regarding plant infestation by *telarius* is as follows: an uninfested plant is one entirely free of mites; an incipient infestation is the presence of a small number of mites of any stage on one or two leaflets of a plant or hill; and a heavily infested plant is one with more than half of its leaves bearing mites.

## Terrestrial Migration

### *Laboratory experiments*

An experiment was performed indoors to determine whether or not *telarius* migrates from plant to plant by crawling over non-plant surfaces. An uninfested, potted, bush-bean plant was brought indoors, and a single leaflet was infested artificially by placing several adult females on it. Six days later, eggs and motile young were present on the infested leaflet in good numbers. At this time, a piece of white cardboard some 18 inches square was perforated in the center with a hole of approximately the diameter of the plant stem and was slit from this hole to the perimeter of one side. The cardboard was fitted around the plant, with the stem passing snugly through the center and the pot supporting the board. A strip of Scotch tape was then applied along the entire length of the slit to obtain a smooth union of the board there. In order to ensnare any mites attempting migration from the plant, "Tree Tanglefoot" was applied to the board as a half-inch-wide band in a large circle around the plant, and the enclosed area beneath the plant was divided into a number of small, closed areas by similar sticky bands. A single 100-watt lamp with reflector was placed a few inches above the plant to provide light for photosynthesis.

Subsequent daily observations over a period of several weeks failed to reveal evidence of mites migrating from the bean plant. One or two mites were occasionally found on the board beneath the plant, but these seemed to have accidentally fallen off the plant. Some of them were dead, and some were entrapped near the middle of the sticky bands, which, in itself, indicated that they had fallen onto the material, for "Tree Tanglefoot" is such a viscous substance that mites remain permanently ensnared where they first

contact it. Observations were continued until all of the leaves on the plant were dead and began to drop. On a few of the more heavily infested and nearly dead leaflets mites congregated into spherical masses some 3 to 5 mm. in diameter at the leaflet apices. They bound themselves together with silken filaments in such masses and finally died in this condition. No mites were observed to spin free of the plant at any time. By the time leaves were dead and fell onto the board below, most mites on them were dead. Few mites were observed to crawl away from leaves after they had fallen, even though some mites actively crawled along leaflets and petioles for several hours before dying.

While the two-spotted spider mite thus does not appear to migrate from plant to plant via the terrestrial route, it does, of course, migrate from leaf to leaf via petioles and stems on a given plant or from one plant to another where these have their foliage in contact. But this foliar migration apparently occurs only under certain environmental conditions or at special times during the mite's life cycle. In the experiment on terrestrial migration described above, the plant was originally infested artificially by placing ten mature females on different portions of a single leaflet. Within a few hours all had migrated to the lower (abaxial) surface of the leaflet and had congregated in a small area approximately 15 mm. in diameter. Here they remained in close association until many eggs had been laid and many of these had hatched. Only after the nymphs had begun to move freely over the lower surface of the leaflet did the surviving adults do likewise to any extent. No migration to the adjacent two leaflets of the same leaf or to other leaves on the plant occurred until some of these first-generation progeny had become adults and most of the remainder deutonymphs. At this time the leaflet was heavily infested and migration happened all at once. The lamp above the plant was turned on one morning at the usual eight o'clock, and migration began within a few minutes. The mites scurried along petioles and stems to other leaves and within 4 hours had infested all the leaves on the plant by thus moving from the single originally infested leaflet.

Observation of numerous other incipient infestations, both natural and artificial, in the laboratory and in the field, indicate that these peculiarities of behavior are normal for *telarius*. Adults tend to band together on newly infested leaves or leaflets possibly because they benefit from each other's webbing. And perhaps their progeny experience a gradually increasing stimulus to migrate as a result of food shortage or "population pressure" and are eventually stimulated to action by a sudden increase, or approach to the optimal, in temperature and/or light.

*Field experiments*

Tests conducted on terrestrial migration in the field were simple and produced negative results. Stems of infested plants were ringed basally with

"Tree Tanglefoot," and microscope slides coated with the same material were placed flat on the ground, sticky-side upward, beneath infested plants to trap any mites dropping from above. Daily observations failed to reveal mites trapped on the plant stems, but a few were caught on the slides. These latter, however, appeared in all cases to have been dislodged from the plant by rain, wind, or possibly by insects.

## Wind Dissemination

*Laboratory experiments*

Brief experiments were performed indoors to test the likelihood of wind dissemination of *telarius* in nature. An upright frame was constructed of ½ x 1-inch boards slotted with a saw at an angle of 45° on their facing surfaces so that 30 microscope slides could be suspended in 3 vertical rows of 10 slides each. Slides coated on their upper surfaces with "Tree Tanglefoot" and inserted in this frame were held with their lengths in the horizontal plane and their widths tilted at an angle of 45°. When loaded with slides the apparatus gave much the appearance of a Venetian blind adjusted to the half-open position, with each slat composed of 3 slides placed end to end (except for the supporting frame members separating them by ¼ inch). The lowermost slides were suspended 3½ inches and the uppermost 18 inches above the base of the frame.

The slide-loaded frame was placed on a table along with a potted, heavily infested, bush-bean plant and a 12-inch electric fan. These three objects were oriented to allow the fan to blow a current of air around and through the infested plant directly toward the frame, with the coated slide surfaces in the latter deflecting the air current upward. The distance between the frame and the center of the plant was 3 feet, and that between the center of the plant and the fan blades was 4 feet. The fan was regulated to deliver a moderate breeze to the plant and allowed to run for 30 minutes under room conditions of 81° F. and "average" fluorescent lighting from the ceiling. The 30 slides were then examined by means of transmitted light under a binocular dissecting microscope. A single mite was found on a slide in the second row below the top of the frame.

Another test was made immediately. The distance between the frame and the center of the plant was reduced to 28 inches and that between the center of the plant and the fan blades to 34 inches so that the fan delivered a stiff breeze or light wind to the plant. The fan speed and room conditions remained as before and the same plant was used. After 1 hour of fan operation the slides were examined as before. Five slides were found to have trapped a total of 15 mites of both adult and immature stages, 2 to 6 mites being stuck to each slide. It thus appeared probable that moderate to heavy winds could disperse *telarius* in the field.

*Field experiments*

Field plots were set up at the Waimanalo Experimental Farm on windward Oahu to investigate wind dissemination of *telarius* in nature. This area receives gentle to moderate, occasionally strong, trade winds, which come directly off the ocean from the northeast and remain rather constant throughout the year. This characteristic of relatively constant wind from one direction seemed to be ideal for the experiments contemplated. Moreover, the mild Hawaiian climate allows the production of many truck crops like beans the year around, and it was decided to conduct field experiments during the cooler and wetter months when natural infestations of *telarius* are at a low level in Hawaii and less likely to contaminate artificially infested field plots.

Three plots were set up. Each plot consisted of three 50-foot rows of Wade bush beans. The rows were 4 feet apart, and each row contained approximately 60 hills of beans spaced 10 inches apart, with generally 2 plants 1 to 2 inches apart in each hill. All three plots were laid out in an east-west direction and were thus so oriented that the prevailing northeasterly wind intersected the rows at an angle of about 45°. It was planned to initiate an infestation at the center of the middle row of one plot and along the entire middle row of another plot. Observations would then be made as often as necessary to record the progress of the infestation over each plot in relation to wind direction.

Five plantings were made on the three plots between November 18, 1955, and June 4, 1956. These were rotated to prevent contamination of an infestation in one plot by that of another. Of the five plantings and subsequent infestations initiated, however, only two were carried through to completion because of storms that destroyed one planting and insect pests that destroyed two others. (One of these was destroyed by the nocturnal, leaf-eating adult of *Adoretus sinicus* Burmeister, the Chinese rose beetle; the other was ruined by larvae of *Hylemyia cilicrura* (Rondani), the seed-corn maggot, which killed exactly 50% of the young plants as they emerged from the soil.)

One of the plantings on which experiments were successfully concluded was of the type in which a single hill near the center of the middle row was infested. The plants at this time were of such age that the first trifoliate leaf on each was approaching full size. In this case it was found necessary to protect the infested hill against storms to prevent eradication of the developing population. Consequently, a miniature greenhouse was constructed of an orange crate, with a waterproof, translucent cover of plastic-coated wire screen over the sloping top and south side. This was firmly secured over the artificially infested hill and an adjacent uninfested hill and allowed to remain in place for eight weeks—until the mites had undergone five or six generations and the originally infested hill bore a very heavy population. After the greenhouse was placed over the 2 hills, 28 days passed before mites were detected on the originally uninfested hill. This delay in the spread of mites from the

infested to the uninfested hill was apparently attributable to restriction of air movement around the two hills to convection currents and light breezes, the latter caused by some wind entering the ventilation openings in the greenhouse. Moreover, on the day when the greenhouse was removed, incipient infestations were discovered on three plants immediately adjacent to the originally infested hill on the west side and on one hill in the southernmost row at a point directly down wind from the originally infested hill.

After removal of the greenhouse from over the two hills, the progress of the infestation over the plot was observed to bear a close relation to the direction of the prevailing wind, i.e., toward the southwest. The infestation immediately began spreading to the west along the middle and southernmost rows. Although the infestation did progress eastward (partially up wind) along the two rows, this movement was much slower than that to the west. The northernmost row also became incipiently infested one to two weeks later at several points, but the mites were likely carried there by reverse gusts of wind during mild storms which occurred in this period. Hills were spaced far enough apart in the rows to prevent contact between plants even at maturity; thus no direct migration from hill to hill via foliage could occur. When the planting finally matured and died, most of the plants (approximately 80%) were mite infested, and nearly all of the uninfested plants were in the northernmost, or windward, row.

During the course of this experiment, tests were also made with sticky microscope slides. These tests were made immediately after the greenhouse was removed from the originally infested hill. Twenty-four slides were coated with tanglefoot and fastened with thumbtacks to 10 slender wooden stakes 18 inches long. The stakes were then placed upright in the soil in a semicircle on the leeward side of the infested hill at distances of from 10 to 36 inches from it. After an exposure of 48 hours the slides were examined microscopically, and, although a rain had splashed soil on the coated surfaces, they were nevertheless found to have trapped six mites. The experiment was immediately repeated, with an exposure period of 24 hours without rain. Examination revealed that 20 of the 24 slides had trapped a total of 153 mites. This included all motile stages, in approximately equal numbers, and three eggs as well. The count per slide ranged from 1 to 48; and those slides closest to, and most directly down wind from, the infested hill yielded the largest counts.

Results of the second successful field planting were similar to those of the first. In this case, however, the entire middle row was infested by transferring mites to a single leaflet of a first trifoliate leaf in each hill. One week later, incipient infestations were discovered in the south or down-wind row, and within another week both the middle and south rows began to show considerable mite damage. Incipient infestations were discovered in the north or up-wind row at this time, but at the time of maturity and death of the

planting some weeks later the north row still contained several uninfested hills.

Interestingly enough, field investigations on dissemination of tetranychid mites by wind were made by E. E. Munger of Yuba City, California, more than half a century ago (reported by Stabler, 1913). Munger worked with an unidentified species, but it appears to have been one of those that spin down from foliage on silken filaments and are then blown about by air currents. Munger exposed sheets of fly paper at various heights and distances from an infested almond orchard and trapped many specimens at a height of 50 feet and a distance of 650 feet from the orchard.

## Conclusions

The evidence that the two-spotted spider mite is normally disseminated by wind seems incontrovertible. This species, however, does not spin down from foliage on a silken filament as do those discussed by Fleschner *et al.* (1956); thus its dispersal probably requires much stronger air currents and likely occurs more slowly, especially in the absence of strong winds, than in the case of those species that spin a silken filament with a parachute-like effect.

Two additional aspects of tetranychid dissemination seem worthy of consideration and remain to be investigated. These are possible dispersal by rain splash and possible egg dispersal by insects. If tetranychids are dispersed by rain splash at all it is probably only for extremely short distances, except perhaps when rain is accompanied by heavy wind. Dispersal of spider mite eggs by insects (accidental phoresy) seems especially likely to occur. For certain tetranychids, including *telarius*, spin a webbing of fine silken filaments over themselves on leaf surfaces and regularly suspend their eggs on such threads. It is difficult to visualize an insect walking over such a leaf without picking up a certain amount of webbing and eggs on its body or appendages, or its failure to leave some of the these eggs on other leaves visited, especially if the leaves be somewhat pubescent.

## Summary

Experiments were conducted both in the laboratory and in the field to determine whether *Tetranychus telarius* (L.) is disseminated by wind or commonly migrates overland between host plants.

Laboratory experiments demonstrated that *telarius* will increase to a heavy population on a bean plant, kill the plant or hasten its death, and then die on the plant or its fallen leaves without any attempt to migrate therefrom. Indoor experiments also showed that air currents generated by an electric fan at moderate speed could carry individual mites from an infested bean plant to adhesive-coated microscope slides 3 to 4 feet distant.

Field experiments showed that the spread of a mite infestation from a given locus within a bean plot occurred in direct relation to the direction of the prevailing wind; i.e., the infestation advanced relatively fast in the direction of the wind and much more slowly against the wind, the latter being probably due to reverse gusts. Moreover, as many as 48 mites, of all stages, were trapped on individual sticky microscope slides held vertically within 3 feet and down wind of infested plants in the field.

It is suggested that experiments be done to test the possibility of tetranychid dissemination by rain splash and the dissemination of tetranychid eggs by insects.

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# Checklist of the Hymenoptera of Fiji

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It is unfortunate, in the writer's opinion, that a detailed and comprehensive study of the insect fauna of the Fiji Islands, similar to the one made by Buxton and Hopkins in Samoa or that of Perkins in Hawaii, has never been made, for it is realized that our knowledge of the Fijian insects up to the present is only fragmentary. Turner, in his report on the collections sent to the British Museum by Veitch, calls attention to this need, stating: "It is important that the fauna should be studied before it becomes too much changed by the ravages of cultivation and the competition of imported forms." The report by Mann of Harvard on the collection of ants made as early as 1917 also comments on the disappearance of the indigenous fauna in most sections where the native forest has been destroyed. My interest has been aroused by obtaining for study the Hymenoptera in the collections of Noel Krauss along with those of Bryan, Zimmerman, Muir, Lever, and others (unfortunately, many of the specimens could not be determined beyond genus status), and in working over these collections for the Bishop Museum I found it desirable to compile a list of the described and recorded species. This list is presented herewith. I have been to considerable pains to make it as complete as possible but I daresay omissions will be noticed. I should be grateful to receive word of such so that the proper corrections can be made.

## BRACONIDAE

*Apanteles agonoxenae* Fullaway: PROC. HAW. ENT. SOC. 11:48, 1941.
*Apanteles artonae* Rohwer: PROC. ENT. SOC. WASH. 28:188, 1926.
*Apanteles belippae* Rohwer: PROC. U.S.N.M. 54:566, 1918.
*Apanteles carpatus* (Say): BOSTON JOUR. NAT. HIST. 1:263, 1831.
*Apanteles expulsus* Turner: TRANS. ENT. SOC. LONDON 1918, p. 346.
*Apanteles glomeratus* L.: SYST. NAT. ed. 10, p. 568, 1758.
*Apanteles heterusiae* Wilkinson: BULL. ENT. RES. 19:127, 1928–1929.
*Apanteles hyblaeae* Wilkinson: BULL. ENT. RES. 19:114, 1928–1929.
*Apanteles hymeniae* Wilkinson: STYLOPS 4:267, 1935.
*Apanteles marginiventris* (Cresson): PROC. ENT. SOC. PHILA. 4:67, 1865.
*Apanteles phytometrae* Wilkinson: BULL. ENT. RES. 19:91, 1928–1929.
*Apanteles platyedrae* Wilkinson: BULL. ENT. RES. 19:133, 1928–1929.

*Apanteles ruficrus* Haliday: ENT. MAG. 2:253, 1834.
*Apanteles samoanus* Fullaway: PROC. HAW. ENT. SOC. 10:402, 1940.
*Apanteles stantoni* Ashmead: JOUR. N. Y. ENT. SOC. 12:20, 1904.
*Apanteles taylori* Wilkinson: BULL. ENT. RES. 19:93, 1928–1929. Introduced.
*Apanteles tirathabae* Wilkinson: BULL. ENT. RES. 19:202, 1928–1929.
*Apanteles* sp.
*Aulacocentrum pedicellatum* Brues: PSYCHE 29:18, 1922.
*Bracon omiodivorum* (Terry): H.S.P.A. EXP. STA. DIV. ENT. BULL. 5:37, 1907. Introduced.
*Bracon* sp.
*Chelonus blackburni* Cameron: TRANS. ENT. SOC. LONDON 1881, p. 559. Introduced.
*Chelonus rugulosus* Lyle: ANN. MAG. NAT. HIST. (9)12:338, 1923.
*Chelonus vitiensis* Turner: TRANS. ENT. SOC. LONDON 1918, p. 345.
*Diospilus* sp.
*Disophrys elegans* Szepligeti: TERM. FUZ. 23:61, 1900.
*Exobracon nitidulus* Brues: PSYCHE 29:13, 1922.
*Ischiogonus fijiensis* Fullaway: JOUR. STRAITS BRANCH R. A. SOC. 80:42, 1919. Endemic.
*Ischiogonus pallidiceps* Perkins: FAUNA HAW. 2:684, 1910.
*Macrocentrus calacte* Nixon: ANN. MAG. NAT. HIST. (11)2:317, 1938.
*Meteorus trichogrammae* Wilkinson: BULL. ENT. RES. 21:158, 1930.
*Microdus hawaiicola* Ashmead: FAUNA HAW. 1:361, 1901.
*Opius fijiensis* Fullaway: PROC. HAW. ENT. SOC. 9:179–180, 1936.
*Opius hageni* Fullaway: PROC. HAW. ENT. SOC. 14:412, 1952.
*Opius humilis* Silvestri: BD. AGR. FOR. DIV. ENT. BULL. 3:103, 1914.
*Opius longicaudatus* Ashmead: PROC. U.S.N.M. 28:970, 1905. Introduced.
*Palinzele oceanica* Brues: PSYCHE 29:15, 1922.
*Perilitus coccinellae* (Schrank): FAUNA BOICA 2:310, 1802.
*Phaenocarpa leveri* Nixon: PROC. R. ENT. SOC. LONDON (B)8:67, 1939.
*Sigalphus* sp.
*Sisupala splendida* Nixon: TRANS. ENT. SOC. LONDON 93:422, 1943.
*Spathius* sp.
*Xenarcha* sp.

ICHNEUMONIDAE

*Campoplex* (*Dioctes*) *tutuilensis* Fullaway: PROC. HAW. ENT. SOC. 10:402, 1940.
*Campoplex* sp.
*Charops infesta* Cresson: TRANS. AMER. ENT. SOC. 4:172, 1872.
*Echthromorpha diversor* Morley: REVIS. ICHNEUMON. 2:47, 1913.
*Echthromorpha fuscator* F.: ENT. SYST. 2:163, 1793. Introduced.
*Echthromorpha immaculata* Krieger: MITT. ZOOL. MUS. BERLIN 4:331, 1909.
*Echthromorpha tirathabae* Perkins: BULL. ENT. RES. 28:171, 1937.

*Hemigaster* sp.
*Henicospilus apicifumatus* Morley: ENTOMOLOGIST 48:139, 1915.
*Henicospilus coarctatus* Brullé: HIST. NAT. INS. HYMEN. 4:146, 1846.
*Henicospilus expeditus* Kohl: TRANS. ENT. SOC. LONDON 1908, p. 315.
*Henicospilus rhoedae* Cheesman: TRANS. ENT. SOC. LONDON 1936, p. 183 (fig.).
*Henicospilus samoana* Kohl: DENKS. AKAD. WISS. WIEN 81:315, 1908.
*Henicospilus turneri* Morley: REVIS. ICHNEUMON. 1:51, 1912.
*Henicospilus* sp.
*Ichneumon promissorius* Erickson: ARCH. NATURG. 8:256, 1841–1842.
*Lissopimpla semipunctata* (Kirby): TRANS. ENT. SOC. LONDON 1883, p. 202.
*Lissopimpla veitchi* Turner: TRANS. ENT. SOC. LONDON 1918, p. 343.
*Mesochorus* sp.
*Metopius* sp.
*Nemeritis palmaris* Wilkinson: BULL. ENT. RES. 19:201, 1928.
*Ophion inutilis* Smith: TRANS. ENT. SOC. LONDON 1876, p. 478.
*Ophion nigritulus* Morley: REVIS. ICHNEUMON. 1:64, 1912.
*Ophion obliquus* Morley: REVIS. ICHNEUMON. 1:50, 1912.
*Ophion* sp.
*Paniscus fijiensis* Brues: PSYCHE 29:19, 1922.
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*Strumigenys* (*Strumigenys*) *scelestus* Mann: BULL. HARV. MUS. COMP. ZOOL. 64(5):463, 1921 (fig.).

*Strumigenys* (*Strumigenys*) *wheeleri* Mann: BULL. HARV. MUS. COMP. ZOOL. 64(5):466, 1921 (fig.).

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*Halictus suvaensis* Cockerell: ANN. MAG. NAT. HIST. (10)3:357, 1929.
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PROSOPIDIDAE

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# Notes on Marine Water Striders of the Hawaiian Islands (Hemiptera: Gerridae)

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(*Presented at the meeting of December 10, 1956*)

Marine water striders are the only insects that inhabit the open ocean. Much has been written about them in accounts of the early voyages of exploration, but modern knowledge is lacking because oceanographers tend to ignore insects and entomologists don't study marine faunas.

Studies by the junior author from January to July, 1955, at the Coconut Island Marine Laboratory of the University of Hawaii resulted in the following: 1) discovery that the open ocean species, *Halobates sericeus* Eschscholtz, feeds on a small anemone; 2) observing that the local Hawaiian species, *Halobates hawaiiensis* Usinger, feeds on any insects that fall into the water; 3) discovery of a remarkable new species of the genus *Hermatobates* on the lee side of the breakwater on the northwest corner of Coconut Island, Oahu, after a Kona storm.

Studies by the junior author at Berkeley and examination of *Halobates* collections from all of the large museums and marine laboratories of the world reveal a pattern of distribution that is unique. Only one nearly cosmopolitan species occurs in the Atlantic Ocean. In contrast to this, the Pacific abounds in species, with three or four species occurring in the open ocean thousands of miles from land and many local species living within the protecting reefs of particular island groups. Water temperatures and ocean currents seem to be the main determiners of the distribution of species. The Philippine-New Guinea area has the greatest number of species, and the genus appears to have arisen from a brackish water group known at present from Japan, Formosa, Korea, and east India.

Two questions were raised by the field work at Coconut Island, and these were the subject of further investigation by the senior author during the summer of 1956. First, it was found that *Halobates hawaiiensis* was limited to the Waikiki area of Oahu and that the individuals were consistently smaller than those collected by the Pacific Oceanic Fishery Investigations vessels off the Kona coast of Hawaii. Second, the new *Hermatobates* was found, but only under very unusual circumstances after a Kona storm at Coconut Island. The *Hermatobates* question, in particular, was a challenge, because this obscure group had been known only from the original collections in the Philippines

(*H. marchei* Coutière and Martin), the Arafura Sea (*H. haddoni* Carpenter), the Gulf of Aden (*H. djiboutensis* Coutière and Martin), and from single collections at such remote spots as the Marquesas, Japan, and Palmyra, Christmas, and Hull Islands. In Hawaii, a single specimen had been collected by Blackburn without precise locality, and a second specimen was taken by E. H. Bryan, Jr., at Gray's Raft, Waikiki, in March of 1922. In 1956, Dr. W. E. China added greatly to the toxonomic knowledge of the subfamily Hermatobatinae, describing the new Hawaiian species (*H. hawaiiensis*)[1] and also two additional species (*H. weddi* and *H. walkeri*) from Monte Bello Islands and the Arafura Sea (northwest of Australia). Still, only a few specimens were known and nothing had been noted on the biology of the group.

The 1956 field work started with certain clues, the most important of which was the record of the POFI collections taken "at light." Accordingly, a sealed-beam headlight was used with a six-volt storage battery. Trips were made to the breakwater where the junior author found his specimens, and also to many other places on windward and leeward Oahu. All attempts were negative for *Hermatobates*, suggesting that the bugs lived in the open ocean (and hence were blown in during the Kona storm mentioned above). While searching for *Hermatobates* in this way, it was possible to confirm the observation of the limited distribution of *Halobates hawaiiensis*. This species swarmed to the light near the Waikiki Marine Laboratory but was never seen elsewhere.

Because *Halobates hawaiiensis* had been taken along the Kona coast of Hawaii, it was decided to try there for *Hermatobates*. Using the same sealed-beam headlight, this time in a fisherman's canoe with outboard motor, the area beyond the lighthouse point at Kailua was worked, and then collecting was concentrated in toward shore at the pier across from the Kona Inn. The large form of *Halobates hawaiiensis* was common everywhere beyond the breakers to at least a mile offshore, but no *Hermatobates* were seen. Then, on returning along the breakwater at the Kailua pier, *Hermatobates* was found hopping on the surface in the midst of specimens of *Halobates*. This spot was revisited the next morning, but several hours of intensive search turned up only a single damaged specimen. From these observations it appears that: 1) *Hermatobates* is not an open ocean insect, i.e., blown in only during Kona storms; 2) it is nocturnal and positively phototropic and consequently has not been taken in the course of general daylight collecting in the past; 3) *Halobates hawaiiensis* is so restricted in its distribution that little or no gene flow occurs between the subspecifically distinct populations on Oahu and Hawaii.

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[1] CHINA, W. E. 1956. A new species of the genus Hermatobates from the Hawaiian Islands (Hemiptera-Homoptera, Gerridae, Halobatinae). ANN. MAG. NAT. HIST. (12) 9(101):353–357.

KEY TO THE HAWAIIAN MARINE WATER STRIDERS

1. Middle and hind legs of approximately equal length, their claws apical; size approximately 3 mm. . . **Hermatobates hawaiiensis** China
   Middle and hind legs of unequal length, the middle ones longer and with a fringe of long hairs, their claws subapical (*Halobates*) . . . . . 2
2. Size small, 3.5 mm.; second antennal segment about one-half as long as fourth . . . . . **Halobates sericeus** Eschscholtz
   Size larger, over 4.5 mm.; second antennal segment longer than fourth . . . . . **Halobates hawaiiensis** Usinger

# Cryptophlebia illepida (Butler) (Lepidoptera: Eucosmidae) and Other Insect Pests of the Macadamia Nut in Hawaii[1]

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*(Presented at the meeting of December 10, 1956)*

The macadamia nut tree was first introduced into Hawaii about 1892. Commercial plantings were made in 1922, and in 1931 a factory was built to process the fruits. Macadamia nut plantings have steadily increased to the present acreage of about 2,750, and this crop has attained an important part in Hawaii's agriculture. Thus far the insect problems on macadamia have been, except in one orchard, of minor importance. With the increase in acreage and plantings being made in new and different locations, more insect problems are to be anticipated.

Of the insect pests found on macadamia in Hawaii, *Cryptophlebia illepida* (Butler), a native Hawaiian moth, has been the most important. It was first reported damaging macadamia nut by Swezey (1919). Swezey stated that the outer husk was eaten and that the larva was observed "in some cases eating the nut somewhat also." This pest has been reported to be present in most of the orchards on Kauai, Oahu, Molokai, Maui, and Hawaii. A 1954 survey of the orchards in the Territory revealed that the orchard at Nutridge, Mt. Tantalus, Oahu, which is the oldest in the Territory, is the only orchard with significant damage done by this pest.

Most of the previous work done on *C. illepida* consisted of observations of hosts and parasites. Swezey (1908) described the egg, larva, and pupa of *C. illepida*; however, the descriptions are not adequate for proper identification. Herein, the descriptions of the immature stages, life history data, parasite and host records, and data on damage are presented.

*C. illepida* has been variously known as the klu tortricid, koa seed moth, koa seedworm, litchi moth, litchi borer, macadamia nut moth, and macadamia nut borer. In the "List of Common Names of Insects Approved by the Entomological Society of America" it is called the koa seedworm.

Other pests of macadamia, all of which have been of minor importance in Hawaii, will be discussed briefly herein.

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[1] Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Technical Paper No. 383.

## Descriptions of Immature Stages of *C. illepida*

*Egg*

Flat, elliptical to circular; length about 0.8 mm., width 0.6 mm. when elliptical. Dorsal surface finely reticulate, slightly convex. Color variable, white or ivory with red spots which appear after first day.

*Larva*

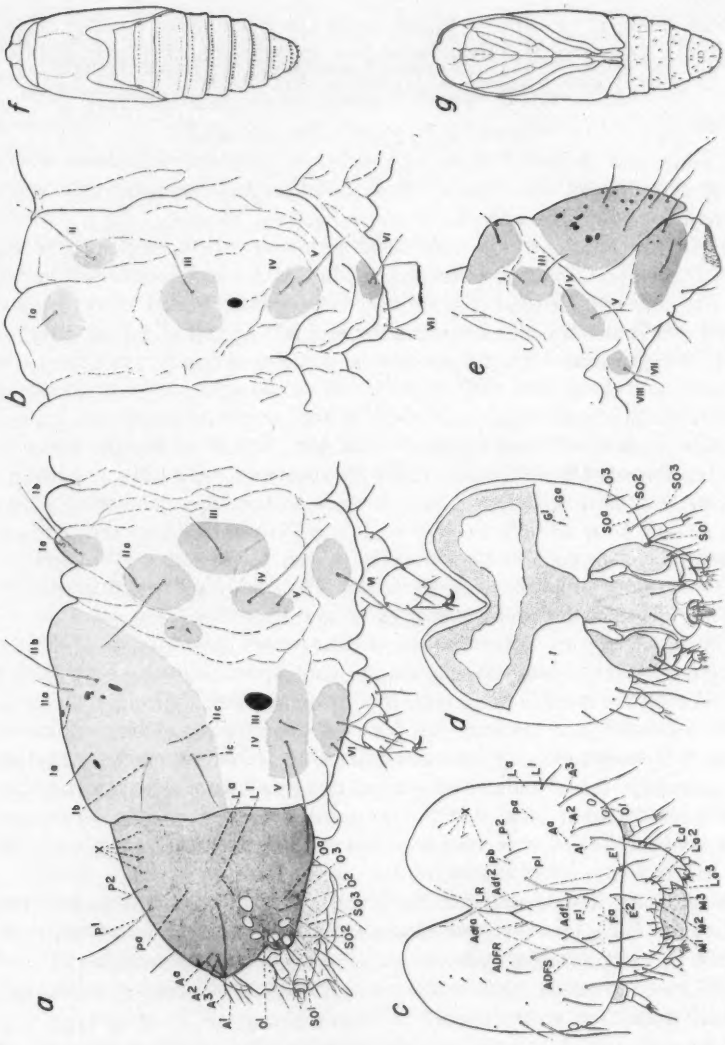
Thorax and abdomen white with infuscate pinacula. Sometimes whole body with pinkish cast. Pinacula in first and second instars difficult to see without aid of microscope.

Head (fig. 1, a, c, d): In fifth instar yellowish brown, blackened at the ocellar circle and latero-posterior corners. In first to fourth instars dark brown or almost black. Cervical triangle deep; in broadest frontal aspect general outline of head capsule somewhat trapezoidal. Adfrontal suture (ADFS) meets longitudinal ridge (LR) at cervical triangle. Suture between front and clypeus indistinct. Seta $Adf^2$ slightly ventrad to apex of front. Puncture $Adf^a$ near $Adf^2$. $Adf^1$ nearer to $F^1$ than to $Adf^2$, one-third or less the distance to $Adf^2$. Seta $F^1$ equidistant from $F^a$ and $Adf^1$. Seta $E^2$ in straight line with and equidistant from $E^1$ and $F^a$. Three ultraposterior setae and one puncture (X) present, all in straight line and about equidistant apart. In lateral aspect $A^1$, $A^3$, and $L^1$ in straight line; $A^2$ slightly dorsad to this line. Distance between $A^1$ and $A^2$ equal to that between $A^3$ and $L^1$. Puncture $O^a$ in straight line with and equidistant from $O^2$ and $O^3$. $P^a$ in straight line with $L^1$ and $P^1$, slightly nearer to $L^1$, equidistant from $A^3$ and $L^1$.

Prothorax (fig. 1, a): Cervical shield light brown except for white median longitudinal strip, with irregular row of dark brown spots on each side of anterior half of median strip, each row diverging laterally from about midpoint of shield; another irregular row of spots present parallel to posterior margin of shield. Oblong, trisetose pinaculum present immediately ventrad to spiracle in lateral aspect; ventrad to this pinaculum a circular, bisetose pinaculum present. Setae VII four in number, located on medio-posterior side of basal segment of true leg. Seta VIII located on venter on small pinaculum located between legs.

Mesothorax and metathorax (fig. 1, a): Pinaculum I oblong, bisetose; pinaculum II circular, bisetose; pinaculum III largest, oval, unisetose; pinaculum IV oval, bisetose; pinaculum VI circular, unisetose. Setae VII and VIII located in similar positions as on prothorax. Small bisetose pinaculum present anterior to pinaculum II.

Abdomen (fig. 1, b, e): Ventral prolegs normal; crochets uniserial, in circle, more or less uniordinal (some crochets shorter than others but not in any regular sequence). Crochets on anal proleg in anterior, transverse, semicircular band, uniserial and more or less uniordinal. All pinacula more or less circular. Segments 1 to 7 with pinacula I, II, III, and VI unisetose, IV bise-


f
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c

tose, VII trisetose. Segment 8 similar to preceding segments except for unisetose pinaculum VII. Pinaculum I on segments 2 to 8 notched anteriorly, notches becoming smaller on posterior segments; sometimes this pinaculum on segments 7 and 8 with circular hyaline spot instead of notch. Pinaculum III sinuated ventrally on first four segments, sinuation gradually straightening on posterior segments. On segments 1, 2, 7, 8, and 9, pinaculum VIII relatively large and conspicuous, located near bases of prolegs on side toward median line. Segment 9 with most dorsad pinaculum fused with corresponding pinaculum of other side, seta II located on this pinaculum; setae I and III located on pinaculum ventrad of the most dorsad one. Ventrad to pinaculum with setae I and III, is a pinaculum with variable number of setae; usually bisetose (IV, V), sometimes trisetose (IV, V, and VI), sometimes bisetose on one side of body and trisetose on other. Pinaculum VII unisetose. Anal shield light brown with scattered dark brown spots. Anal comb lacking.

*Pupa*

Light brown, often becoming dark brown when nearing eclosion. Abdominal segments 2 to 7 each with two transverse rows of stout, conical spines on dorsum (fig. 1, f ). Spines of anterior row on each segment larger than those of posterior row; spines of anterior rows progressively larger posteriorly. Spines on segments 2 to 7 variable in number and position. Segment 1 without spines; segments 8 and 9 with only anterior row. On segment 8 number of spines varies from 6 to 11; on 9 from 5 to 9. Segment 10 with 2 to 5 spines dorsad and one on each side of anal opening. Wing tips reach anterior portion of segment 3 (fig. 1, g).

*Adult*

The adult of *Cryptophlebia illepida* was first described by Butler (1882) as *Teras illepida*. Subsequently Walsingham (1907) placed it in *Cryptophlebia* with a redescription. In addition Walsingham described two new varieties of *C. illepida* (var. *fulva* and var. *suffusa*) and two new species of *Cryptophlebia* (*C. tetrao* and *C. vulpes*). Zimmerman (1946), after observing the great variation of size, color, and color pattern in this complex, considered the problem of conspecificity of the above mentioned varieties and species. He noted the uniformity of the male genitalia of otherwise varying specimens from different places and hosts, and is of the opinion that this complex taxon is one species. I have made similar observations and am of the same opinion.

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FIG. 1. *Cryptophlebia illepida* (Butler). *a–e*, larva: *a*, lateral aspect of head, prothorax, and mesothorax; *b*, lateral aspect of third abdominal segment; *c*, frontal aspect of head; *d*, posterior aspect of head; *e*, lateral aspect of ninth and tenth abdominal segments. *f*, *g*, pupa: *f*, dorsal aspect; *g*, ventral aspect.

Swezey and Zimmerman (1946), following Meyrick (1910), place *illepida* in *Argyroploce*. Bradley (1953), in his review of some of the important species of *Cryptophlebia*, places *illepida* in this genus.

The reader is referred to Walsingham (1907) for the adequate description and illustrations of the adult of this species.

## Biology of *C. illepida*

### *Egg*

Eggs are laid on and stuck to the surface of the husk of the macadamia fruit in clusters or single isolates. Usually, if in clusters, the margins of the eggs slightly overlap. In cages when ovipositional sites are limited, eggs are often laid on the peduncle of the fruit. In the orchards, unhatched viable eggs can be found on fruits one-half inch in diameter to ones fully matured. Usually three or fewer eggs are laid on one fruit; however, single fruits with as many as 15 eggs have been seen.

The egg when first deposited is white. Red spots appear on the dorsal surface on the second day and increase in number on the third day. On the fourth day these spots become confluent and cover most of the dorsal surface. Just before the dark brown head capsule and cervical shield are apparent through the egg shell, the red spot begins to disappear. At the time of hatching no red is visible. The eggs hatch in from three to five days. If the hatching time is less than five days, the color change is proportionally hastened.

### *Larva*

The larva chews its way out of the egg when hatching. Often after emerging from the egg it will insert its head back into the egg to eat the contents. Usually the larva crawls away from the egg shell and bores into the husk, but less frequently it bores directly into the husk from within the egg shell. When the hole is about one-half body length in depth, the first-instar larva forms a shield over the hole and itself with silk and excrement and appears to rest before continuing to bore. It bores directly to the shell and then along the husk next to the shell. If the shell is still soft, it may bore through the shell to the kernel; however, this does not occur until the second or later instars. Sometimes a larva will leave one fruit and enter another.

The larva, if it enters the husk in the third or later instars, will manifest its presence within the fruit by extruding excrement through the entrance hole of its tunnel. If it enters the husk in the first instar, the hole calluses over with the disappearance of the excrement shield and only a black dot remains. The larvae are negatively phototropic and/or positively thigmotropic, inasmuch as they seek dark and tight places.

As many as seven larvae, a mixture of all instars, have been observed in one fruit. All stages, including the first instar to the pupa, can be found on

matured but not-yet-dried-up fallen fruits. The larva does not feed on dried husk; therefore, it must pupate before this condition occurs in order to survive. In the field the husk of immature and mature fruits on the ground will dry up in about six days in the absence of rain. Attempts were made in the laboratory to rear larvae on fully matured kernels. The fourth- and fifth-instar larvae developed to the adult stage but the first three instars died without molting.

The larva when disturbed will eject a drop of amber liquid from its mouth. The significance of this, if any, was not ascertained.

To determine the number of instars and the duration of each stadium, larvae were reared individually in petri dishes on fresh sections of young macadamia fruit. Larvae were dissected out of the sections at about the same time each day to see whether molting had occurred, then they were placed back into the petri dishes with fresh sections of macadamia. The data obtained are presented in table 1.

There are five larval instars in *C. illepida*. In this study the total number of individuals descreased from instar to instar because of death or escape. The mean duration of the entire larval stage, obtained by adding the mean durations of all the instars, was 16.3 days. This figure comes close to the mean duration of 16.2 days, which was obtained from the total larval period of each individual (table 2).

The applicability of Dyar's rule for the determination of the number of instars for this species was investigated. Head width measurements of larvae of known instars, reared under similar conditions, were taken. When represented on a graph, the first three instars showed discontinuous, unimodal groupings, but the fourth and fifth instars showed considerable overlapping and no definite peaks. Since all larval instars can be found throughout the year at the orchard at Nutridge, samples of larvae were taken periodically and their head width measured. A graphic representation of the measurements showed no distinctive groupings or peaks even in the earlier instars. The above observations indicate that Dyar's rule is not applicable to this species under the conditions observed.

After each molt the larva eats rapidly until engorged, then appears to be quiescent (usually a day) until the next molt. When molting, the head capsule is shed by backing out of it, and the body skin by wriggling out forward.

About two days prior to pupation, the larva spins a cocoon of silk and excrement around itself and remains quiescent until it pupates. By this time the vast majority of the infested fruits have fallen to the ground.

*Pupa*

Pupation occurs in the tunnel near an exit hole in the husk. Sometimes, when the husk splits before pupation, the cocoon may be built along one edge of the crack. When the pupa is first formed it is light brown, then

gradually becomes darker, and when time for adult emergence it is almost black. The pupa wriggles two-thirds of the way out of the cocoon and extends through the exit hole when nearing eclosion.

TABLE 1. The duration of the larval and pupal stages of *C. illepida*.

| INSTAR | NUMBER INDIVIDUALS | RANGE OF DURATION IN DAYS | MEAN DURATION IN DAYS | STANDARD DEVIATION |
|---|---|---|---|---|
| 1 | 106 | 2–6 | 3.38 | 0.75 |
| 2 | 83 | 1–5 | 2.38 | 0.68 |
| 3 | 74 | 1–4 | 2.20 | 0.68 |
| 4 | 65 | 1–6 | 2.40 | 0.82 |
| 5 | 56 | 3–8 | 5.93 | 1.28 |
| pupa | 48 | 8–12 | 9.56 | 1.18 |

TABLE 2. Frequency distribution of *C. illepida* larvae with reference to total larval period.

| No. days | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|
| No. individuals | 1 | 3 | 10 | 18 | 20 | 4 |

Total number individuals = 56
Mean duration of total larval period (days) = 16.2
Standard deviation = 1.02

*Adult*

The adult is able to fly almost immediately after emergence. Its activity is usually nocturnal. During the day adults are found among the fallen leaves and in crevices of the trees. Mating and oviposition in the field probably occur at night, inasmuch as this was the only time they were observed to occur in the laboratory.

Table 3 represents a laboratory study of the number of days after emergence that the females laid their first eggs. The eggs were fertile. The females were paired with males of the same age on the day of emergence.

To obtain information on mating and reproduction, adults were reared on honey-water in tin-can cages. These cages were made by removing the tops and bottoms of the cans and covering the open ends with screen discs. The discs were held in place with the rims of the covers of ice cream cartons. In one screen a hole, which was plugged with a cork, was made to facilitate feeding and transfer of specimens. The inner surface of the can was lined with wax paper upon which the eggs were laid. The wax paper was easily taken out for study of the eggs.

During the course of this study the following information on mating and reproduction was obtained:

1. Individual virgin females kept isolated laid eggs after becoming two days old, but these eggs did not hatch. Such eggs, when examined microscopically, showed no sign of embryonic development.

2. Reproductively matured females laid fertile eggs the same day they were paired with fertile males.

3. Only males more than two days old were able to fertilize females.

4. Some females laid fertile eggs up to four days after the males were eliminated.

5. Oviposition usually occurred daily, once it was initiated.

6. The longest egg-laying period observed was six days.

7. The oldest female which oviposited was 11 days old.

8. The maximum number of eggs laid in a single day by an individual was 128.

9. The maximum number of eggs laid by an individual was 367, laid over a period of four days. Another individual laid 328 eggs in six days.

TABLE 3. Frequency distribution of adults of *C. illepida* with reference to age at initial oviposition.

| Days after emergence.. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No. adults..... | 0 | 8 | 10 | 8 | 6 | 1 | 2 | 0 | 0 | 1 |

Total number females = 36
Mean age at initial oviposition = 3.8 days

## DAMAGE TO MACADAMIA BY *C. illepida*

Damage to macadamia by *C. illepida* is confined to the fruit. Fruits one-half inch in diameter to matured size are attacked. In young fruits, if damage is extensive enough, development is arrested, and the fruits may drop to the ground or may remain attached to the axis of the raceme and eventually dry up. If damage is slight and confined to the husk, development may continue to maturity without any apparent effect. Usually when the shell is damaged in the young stage but development continues, the shell at fruit fall is distorted and undersized. The kernel is then undersized but not distorted.

To ascertain whether larvae bored through the hard shell as reported by Williams (1936), seven to ten larvae, a mixture of second or older instars, were placed on a caged cluster of four or five fruits that were on the tree. The shell of each fruit was tested for hardness by hand with an insect pin. All shells appeared to be fully hardened, since as with the shell of fallen, matured, dry fruits, the pin point could hardly break the surface of the shells. A total of 10 clusters was involved. The fruits were examined after they had fallen inside the cage and the husks dried up. Although the inner layer of the husks was almost completely eaten, no complete penetration of the shells was observed. During the course of this study, thousands of shells were examined and occasionally shallow excavations in the shells, most probably made by *C. illepida* larvae, were observed. It appeared as though attempts

were made to bore through the shells, but that the hardness "resisted" such efforts.

Sometimes, from the appearance of the hole (clean-cut edge and no distortion of the shell), it seemed that boring through occurred when the shells were fully hardened. A probable explanation of this is that larvae bored through when the shells were of mature size but were not yet fully hardened. This was observed to occur in many cases in which the matured fruits later showed no shell distortion but did show holes in the shell with clean-cut edges.

*C. illepida* larvae usually damage the kernels only partially, and these can still be sold at a lower price. However, an important consideration is that a hole through the shell provides an avenue of entry for fungi, nitidulid beetles, and ants, which completely damage the kernel.

At the macadamia orchard at Nutridge, the heaviest crop of matured fruits appears from September through January; however, fruits suitable for *C. illepida* infestation (one-half inch in diameter or more) are found throughout the year. Thus, the orchard by itself can and does maintain a *C. illepida* population throughout the year. The largest number of fruits suitable for infestation is found on the trees from June to the end of the year, but proportionally more young fruits are found in June and July than in the later months.

During 1954, infestation data were obtained which are presented in figure 2. To obtain the data, 200 fruits were picked at random from throughout the orchard at about the middle of each month. These fruits were green, more than one-half inch in diameter (suitable for infestation), and on the ground.

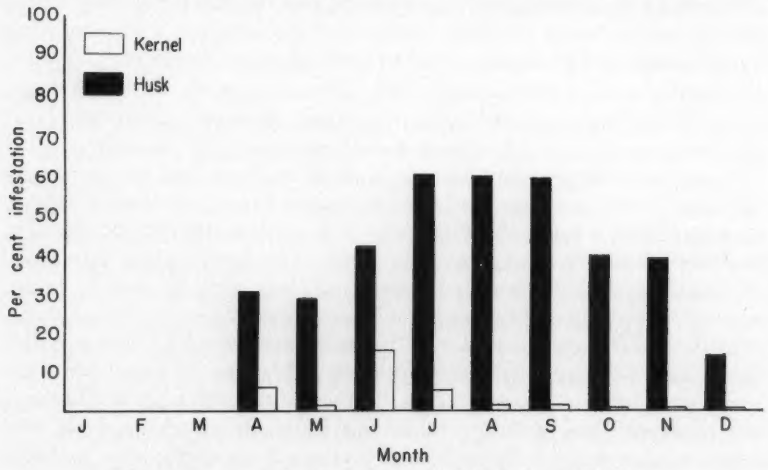


FIG. 2. Per cent infestation of macadamia fruits by *C. illepida*.

In view of their fresh condition, they were on the ground probably for not more than three days. A fruit was considered infested when one or more larvae had penetrated the husk. One to seven larvae were found in each infested fruit.

The average number of larvae per infested fruit in the samples was essentially the same throughout the year; however, the percentage of fruits with husks damaged increased rather sharply beginning in June and reached its highest levels in July, August, and September. Since during this period there were as many fruits of suitable size for infestation as at any other time of the year, the highest larval population is indicated for this period. This high population could be a manifestation of a usual annual rise in the density of a population maintained in the orchard or the result of a migration of adult moths to macadamia from other hosts. In the vicinity of Nutridge the only favorable host that occurs in abundance and on which there is a large population of *C. illepida* is *Acacia koa* Gray. Therefore, if migration had occurred, it most probably was from *A. koa*. This viewpoint appears especially favorable in light of the fact that that year the koa pods dried up in June and were no longer available as hosts.

The percentage of kernel damage was highest in June. This damage could have been expected since there were proportionally more fruits suitable for infestation with penetrable shells at that time than at any other time of the year.

## Hosts Plants of *C. illepida*

From the list below it is evident that *C. illepida* has a wide range of hosts. It is found frequently on *Acacia koa*, *A. confusa*, *A. farnesiana*, *Macadamia ternifolia*, and *Sapindus oahuensis*, and less frequently on the other hosts.

Referring to *A. koa*, Swezey (1954) states that "Often a high percentage of seeds is destroyed so that it is sometimes difficult to obtain seeds for planting in reforestation projects." In counts obtained at various locations on the islands of Oahu and Hawaii, Swezey has obtained seed destruction of 10 to 99 per cent. Out of 200 randomly picked pods examined by the present writer from Mt. Tantalus, Oahu, in 1954, 21.2 per cent showed *C. illepida* infestation. Usually about half of the seeds in a pod were destroyed.

In the present work, the garden string bean was found to be an excellent food for the laboratory rearing of the larvae.

### Leguminosae

*Acacia confusa* Merrill
*A. farnesiana* (L.) Willdenow
*A. koa* Gray
*A. koaia* Hillebrand
*Cassia glauca* Lamarck
*Inga edulis* Martius
*Phaseolus* sp.
*Pithecellobium dulce* (Roxburgh) Bentham
*Mezoneurum kauaiense* (Mann) Hillebrand

Sapindaceae

*Alectryon macrococcum* Radlkofer
*Dodonaea viscosa* Jacquin
*Litchi chinensis* Sonnerat
*Sapindus oahuensis* Hillebrand
*S. saponaria* L.

Proteaceae

*Macadamia ternifolia* Mueller

Anacardiaceae

*Mangifera* sp.

### Parasites of *C. illepida*

Of the hymenopterous parasites listed below, I have reared *Horogenes chilonis*, *Pristomerus hawaiiensis*, and *Coccygomimus punicipes* from *C. illepida* larvae infesting macadamia and *A. koa* at Mt. Tantalus, Oahu. Only the third, fourth, and fifth instars were observed to be parasitized by these parasites.

Ichneumonidae

*Cremastus hymeniae* Viereck
*Coccygomimus sanguinipes* (Cresson)
*C. punicipes* (Cresson)
*Horogenes chilonis* (Cushman)
*Pristomerus hawaiiensis* Perkins

Chalcididae

*Brachymeria obscurata* (Walker)

Braconidae

*Bracon mellitor* Say

Eulophidae

*Omphale metallicus* Ashmead

Bethylidae

*Perisierola emigrata* Rohwer

Dryinidae

*Sierola cryptophlebiae* Fullaway

### Control of *C. illepida*

Parasites are apparently important in keeping the population of *C. illepida* down; however, other means must be sought for adequate control. During the course of this study, it became evident that cultural measures of control appeared most promising.

Cultural measures of control appear suitable as well as economically feasible. Such measures could be incorporated into the general orchard practice at little or no additional cost. The following cultural measures of control are recommended after studying the biology of this species.

1. For a new orchard it would be preferable to select a site where there are no favorable hosts, especially *A. koa*. However, if they are present they should be eliminated if possible. This prevents the possibility of migration of adults to macadamia.

2. Select varieties of macadamia that fruit at about the same time. This would provide a fruit-free period long enough so that a population maintained within an orchard could be eliminated. Furthermore, fruiting at the same time would be advantageous in the general orchard practice.

3. Pick up fruits at least every seven days and cart away from the orchard. In the study of the biology of this species, the shortest pupal period observed was eight days and pupation occurred after the fruits had fallen to the ground. Therefore, if fruits were picked up at the recommended interval and carted away, the adults would emerge away from the orchard and would not be able to infest the fruits still on the trees. If the factory is located in the vicinity of the orchard, the fruits should be husked as soon as possible. Many larvae and pupae will be killed in the husking process. Those not killed should be eliminated by other means if practical.

Studies on the biology of this species revealed several factors which indicated that at present the cost of chemically controlling *C. illepida* exceeds that caused by this pest and thus chemical control is not economical. A long period of insecticidal coverage that is necessary and the difficulty of application due to the dense foliage of macadamia, appear to be the most important factors which contribute to the high cost of chemical control.

## Other Pests of Macadamia Found in Hawaii

Pests of macadamia in Hawaii, other than *C. illepida*, are of minor importance at present. They occur in small numbers and are encountered only occasionally.

*Toxoptera aurantii* (Boyer de Fonscolombe) (Homoptera: Aphididae), the black citrus aphid. This cosmopolitan immigrant has a wide range of hosts and is usually found in the higher elevations. It attacks the flowers and newly set fruit of macadamia, causing drop. Fortunately this is only a minor pest in Hawaii, perhaps because most of the macadamia are planted in the lower elevations.

*Selenothrips rubrocinctus* (Giard) (Thysanoptera: Thripidae), the red-banded thrips. This widespread species attacks the leaves and fruits of macadamia. In August, 1956, a rather severe infestation of this pest occurred at Keaau Orchard, Hawaii. In the most severely infested areas, the vast majority of the matured fruits were completely spotted with the dried excrement of this thrips. Since the fruits were matured, damage was of no economic significance. It appears that this pest attacks only the matured fruits, inasmuch as young fruits even in the most severely infested areas were not attacked. Leaves were attacked but damage was negligible, both in number of leaves attacked and in degree, even in the most severely attacked trees. This species was observed on young leaves but there was no apparent damage. No thrips was observed on trees without fruits. Apparently this species is first attracted to the macadamia fruits, then spreads to the leaves after attacking the fruits.

*Pheidole megacephala* (F.) (Hymenoptera: Formicidae), the big-headed ant. This pest is a secondary invader of the kernel. It can gain entrance to the inside of the shell only through a hole in the shell, which in Hawaii is most likely made by *C. illepida*. These ants will completely devour the kernels which *C. illepida* larvae have left only partially eaten. Fortunately, *P. megacephala* is encountered only occasionally in *C. illepida*-damaged kernels. Probably *P. megacephala* damage would be greater if the fruits were on the ground or in storage for longer periods.

*Carpophilus* sp. (Coleoptera: Nitidulidae). These beetles, like the big-headed ants, gain entrance to the kernel and devour it in the same manner. They are probably attracted only to kernels that have become rancid. These beetles transform the kernel into a powdery mass.

The following insects have been reported doing some damage to macadamia. There is only a single report of each in the literature.

*Amorbia emigratella* Busck (Lepidoptera: Tortricidae), the Mexican leaf roller. This species was reported as a pest of the young trees. There is no mention of the extent of damage.

*Achaea janata* (L.) (Lepidoptera: Noctuidae). This species was observed attacking leaves.

*Anacamptodes fragilaria* (Grossbeck) (Lepidoptera: Geometridae). This species was observed feeding on young foliage.

*Fiorinia fiorinae* (Targioni-Tozzetti) (Homoptera: Coccidae). An infestation of this scale on a leaf was reported.

*Vanduzea segmentata* (Fowler) (Homoptera: Membracidae). All stages of this insect were observed on young macadamia seedlings. They were feeding at the bases of the petioles near the tip of the growing point; however, no injury was apparent.

*Dacus dorsalis* Hendel (Diptera: Tephritidae), the oriental fruit fly. The reported infestation was on prematurely fallen, immature fruits, the kernels of which were exposed by splitting of the shells by unknown means.

In Australia, the home of the macadamia nut, there are several insect pests of macadamia, which are important economically. In the QUEENSLAND AGRICULTURAL AND PASTORAL HANDBOOK, vol. 3, there is a complete list of pests of macadamia reported from Australia, with biological notes on each.

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# A New Genus and Species of Oribatei (Acari) Exhibiting External Sexual Dimorphism

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(*Presented at the meeting of December 10, 1956*)

Although bisexuality is the rule in the Oribatei, the suborder is unique in the nearly complete absence of external structural characteristics differentiating males and females. Oudemans (1896) was the first to point out sexual differences in species of *Hydrozetes* Berlese, 1902, when he showed that in males of a species which he erroneously took to be *Hydrozetes confervae* (Schrank, 1781) there was a special seta of unusual form on tarsus I. Koenike (1911), apparently without knowledge of Oudemans' work, showed that in a species which he identified as *Hydrozetes lacustris* (Michael, 1882) the two sexes could be differentiated by the interval separating the genital and anal openings. In that species the genital and anal openings of the female are separated by a distance only about equal in length to the genital opening, while in the male this interval is considerably greater than the length of the genital opening. The present writer (1945) and Grandjean (1948, 1949) provided further information on external sexual dimorphism in *Hydrozetes*. Briefly, males in this genus can be distinguished from females either by the presence of a greatly enlarged seta on tarsus I or the interval between the anal and genital openings or both. It is also of interest that males in some species of the genus are exceedingly rare, sometimes comprising less than one per cent of a given population.

A less well-known case is found in *Galumna dorsalis* (Koch, 1836) (=*Zetes d.*). In his original description of that species, Koch pointed out that he had observed individuals in copula, and that one of the sexes had two posterior teeth on the hysterosoma and a sharp process between them. He did not, however, specify which sex was so characterized. Some later workers apparently missed Koch's observations, for male and female were actually described under different specific names. Thus *Oribates elimatus* Berlese is evidently the female of *Galumna dorsalis*, and *Galumna* (*Centroribates*) *mucronata* (G. and R. Canestrini) is probably the male (Grandjean 1935, p. 244). Moreover, Berlese (1914, p. 122, pl. 1, fig. 8) established the subgenus

[1] The drawings in this paper were prepared by Mari Riess of the University of California at Riverside. The scales are marked off in 10 $\mu$ units. This study was supported by a research grant from the University of California at Riverside.

*Centroribates* for the male of *Galumna dorsalis* Koch (=*Oribates mucronatus* G. and R. Canestrini). Further details of the nomenclatorial difficulties stemming from this may be found in papers by Grandjean (1935) and Vitzthum (1940, page 447). *Galumna uropygium* (Grandjean, 1928), originally described as *Centroribates uropygium*, is evidently distinct from *G. Dorsalis* (Koch). This species also exhibits sexual dimorphism.

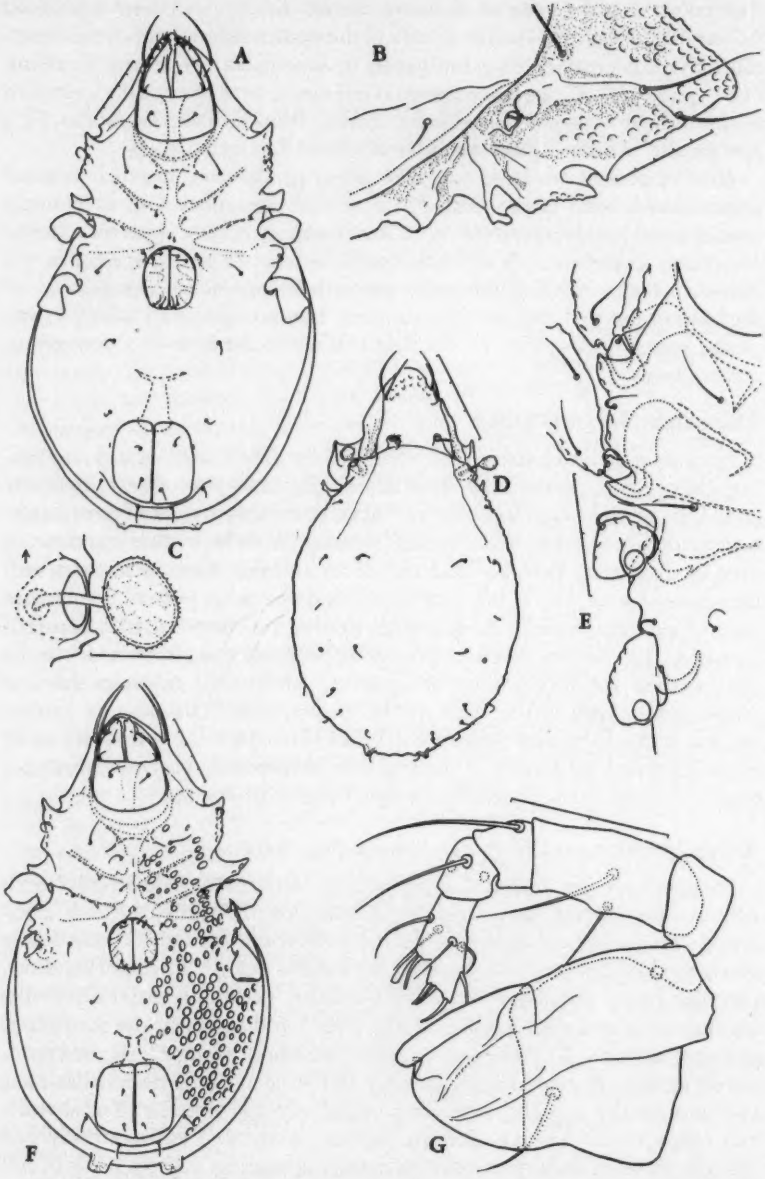
Thus at present we have only one genus of Oribatei in which external sexual dimorphism is the rule, and a second one containing exceptional species in which the sexes can be differentiated by readily apparent external structures. Therefore it is of considerable interest to find a species in the Hawaiian fauna in which the males and females can be easily separated on the basis of external structure. This species does not appear to belong in any of the presently described genera, and it is made the type of a new genus, *Anisochthodes*.

**Anisochthodes,** new genus

Propodosoma and hysterosoma separated by only a feeble transverse line. Sensilla capitate, parasensillar setae absent. Pteromorphae absent. Epimeral areas I, II, and III clearly delimited, IV open posteriorly. A pair of setae immediately anterior to the genital opening, separated from each other by a distance little or no greater than the diameter of an alveolus. Genital sclerites with four pairs of setae, two at the anterior end and two at the posterior end; three pairs of genital acetabula. Anal sclerites bearing two pairs of setae. A pair of conical or papilliform tubercles present at posterior margin of body, at the tips of which are the openings of a pair of glands; these tubercles showing sexual dimorphism in the type species (fig. 3, E, F). Chelicerae of normal chelate form. Palpi five-segmented; tarsus with an erect solenidion at or slightly beyond the middle of the segment, immediately distad of which is a eupathid; three other eupathidia at tip of segment (fig. 3, H).

**Anisochthodes papillifer,** new species (figs. 1-3)

Female: Body (fig. 1, D) 351 to 369 $\mu$ long, 189 to 207 $\mu$ wide, length/width 1.74 to 1.86; average 360 $\mu$ long, 203 $\mu$ wide, length/width 1.77 (five specimens). Propodosoma delimited from hysterosoma by only a very feeble transverse line between the levels of the sensilla and the interlamellar setae. Lamellae feebly developed but always present, extending anteriorly to the lamellar setae and then anteroventrally over the margins of the rostrum as prolamellae (fig. 1, B). Lamellar and rostral setae both elongate, slender, moderately curved, directed anteriorly, very feebly pectinate. Interlamellar setae stiff and usually straight, extending posteriorly and dorsally. Translamella and cusps totally lacking. Sensilla capitate, extending anterolaterally and upward; swollen distal portion with margin appearing slightly spiny in full dorsal view. Parasensillar setae absent. Lateral portion of propodosoma with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a distinct pore anterior to the insertion of the sensillum; with sculptured and punctate areas as shown in figure 1, B. Internal posterodorsal apodemes of propodosoma totally lacking. Dorsal surface of hysterosoma uniformly marked with circular panels which are larger in the anterior half than in the posterior half; with ten pairs of setae distributed more or less as shown in figure 1, D, variable in position (especially those behind the opening of the oil gland). A small pore a short distance directly behind the first pair of hysterosomal setae, and a similar pore slightly posteromediad of the opening of the oil gland. Opening of oil gland at posterior end of sac. Anterior to the opening of the oil gland is a slit pore. Extending posterolaterally from the origin of the lamellae is a pair of elongate grooves, tapering gradually and vanishing slightly behind the level of the first pair of hysterosomal setae. At the posterior end of the hysterosoma is a pair of prominent papillae, slightly excavated at the tip and containing a canal which continues internally as the duct of a subcuticular gland (fig. 3, E). Areae porosae absent.

Epimeral areas I, II, and III well delimited by apodemes 1, 2, sejugal, and 3, all of which reach to the well developed sternal apodeme. Sejugal apodeme well developed; but apodeme 4 totally absent. Epimeral area I with three setae, II with only one at the medial angle, III with one long seta near the anterior margin, IV completely open posteriorly and with three setae on each side. Tectopedia I and II not unusually developed. Discidium fairly well developed, forming a bidentate lobe as seen in ventral view. Immediately anterior to genital opening is a single pair of small setae, the alveoli of which are usually separated by a distance less than the diameter of one of the alveoli. Ventral plate with four pairs of setae behind genital opening distributed as shown in figure. Ventral surface marked with circular panels similar to those of dorsum. Three pairs of genital acetabula. Mature eggs very large, ranging up to 165 $\mu$ in length, never more than two present at one time, these nearly filling the hysterosoma. Anal sclerites bearing two pairs of setae, cuticle marked with minute circular panels.

Maxillae as shown in figure 1, G, with two pairs of setae; base of gnathosoma with a single pair as typical for Oribatei in general. Palpi five-segmented, femur and patella distinctly separated. Chaetotaxy of palp 0–2–1–3–10 (two specimens checked). Five of the tarsal setae are normal setae, extending from $0.24d^2$ to $0.68v$; while the others are a solenidion at $0.59d$ and four eupathidia distributed as shown in figure 3, H. Cheliceraein both male and female with one dorsal seta and one seta posteriorly near base of tarsus, Trägårdh's organ a long pointed membrane on the anterior surface (fig. 3, K). Jaws and teeth of chelicerae quite heavy. Trochanters I-IV each with a single seta. Femora

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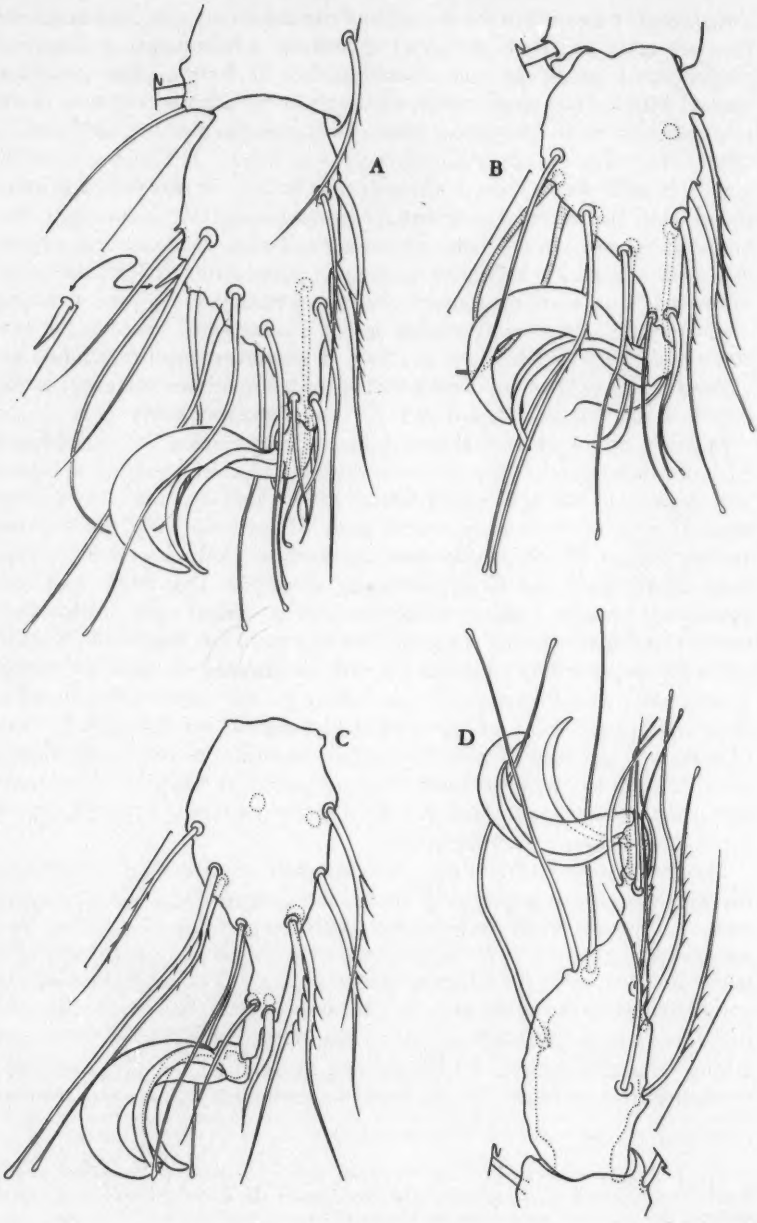
FIG. 1. *Anisochthodes papillifer*, n. sp. A, venter, female. B, detail of dorsolateral wall of propodosoma, female. C, sensillum, dorsal view, female. D, dorsum, female. E, detail of epimeral area and body margin, female. F, venter, male. G, palp and maxilla, female.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I and II each with two fairly stout hemipectinate setae dorsally, the basal one more erect than the distal one; dorsal setae of femur III moderately erect, but considerably more slender than those on I and II. Patella of legs I to III each with a dorsal solenidion, that on III quite short. Tibial solenidia numbering 2–1–1–1; both III and IV with a very long and typically formed solenidion.

Tarsus I with a slender, spike-like famulus at 0.41*d*, anterior to which are two slender, curved solenidia tapering to a moderately sharp point (fig. 2, A). At the end of the tarsus are the usual two pairs of setae, only the dorsal ones hollow basally, the ventral ones solid throughout; otherwise with 13 normal setae, seven of which are knob-like terminally.

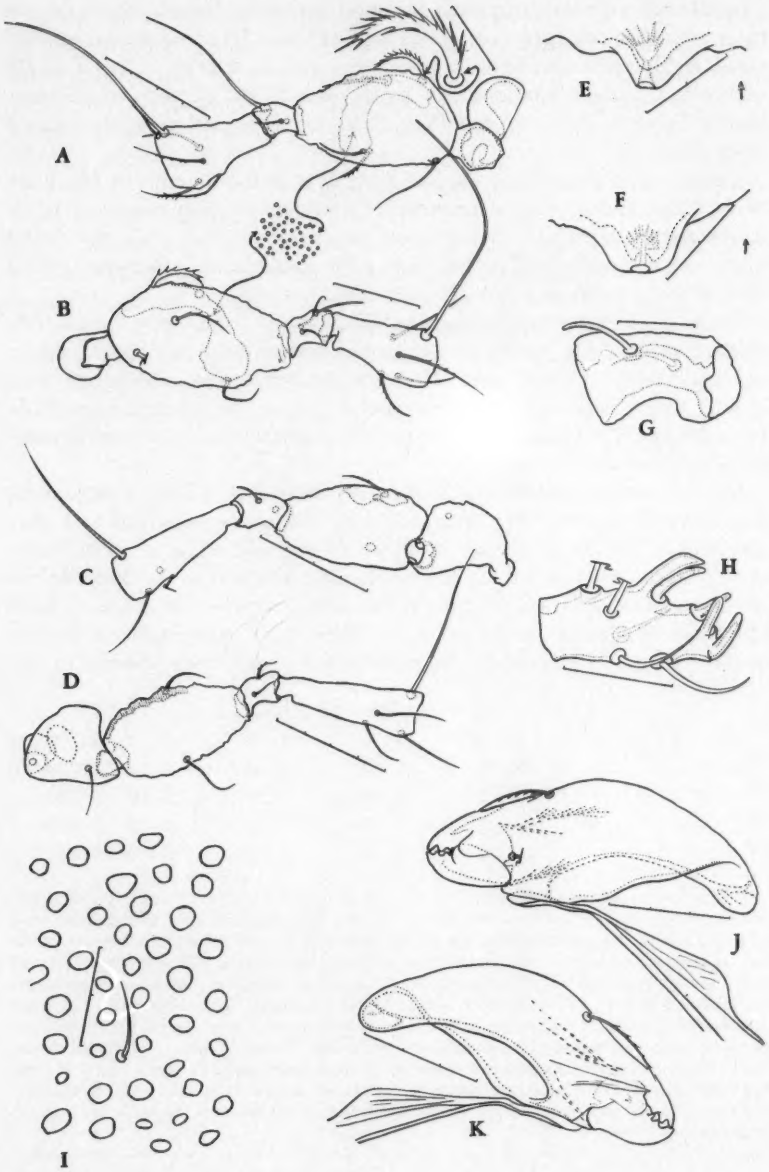
Tarsus II with no hollow eupathidia, although there are the usual two pairs of setae at the end of the segment. Capitate setae not so commonly enlarged as on I. Tarsi III and IV also without typical eupathidiform setae at end. Other details of chaetotaxy are shown in the accompanying table (s = solenidia, e = typical hollow eupathidia, f = famulus, n = normal setae, c = companion seta).

Male: Somewhat smaller than female, 297 to 351 $\mu$ long, 162 to 189 $\mu$ wide, length/width 1.75 to 1.86; average 324 by 170 $\mu$, length/width 1.82 (five specimens). Similar to female in all other essential respects noted above except for the form of the papillae on the posterior end of the body. In the female these are quite sharply conical, but in the male they are distinctly more block-like in appearance (fig. 3, E, F). There is no intergradation, so that in the specimens observed by the writer it has always been possible to dis-

| | TR | FE | PA | | TI | | TA | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | n | s | n | s | n | s | e | f | n | c |
| I | 1 | 5 | 1 | 2 | 2 | 4 | 2 | 2 | 1 | 13 | 0 |
| II | 1 | 5 | 1 | 2 | 1 | 4 | 2 | 0 | 0 | 15 | 0 |
| III | 1 | 3 | 1 | 1 | 1 | 3 | 0 | 0 | 0 | 15 | 0 |
| IV | 1 | 2 | 0 | 2 | 1 | 3 | 0 | 0 | 0 | 12 | 0 |

[2] This convention was introduced by the writer at one point in an earlier paper (1956) without explanation. It is often desirable to indicate the precise position of particular setae or structures on the segments of a leg or palp, but this is usually laborious because of the lack of a system of notation which is both convenient and precise. The statement "Tarsus I with a famulus at 0.41*d*" is considerably briefer and more meaningful than such a statement as: "Tarsus I with a famulus dorsally, a little before the middle of the segment." The terms dorsal, ventral, anterior, and posterior (abbreviated *d*, *v*, *a*, *p*) are employed to express orientation with relationship to the longitudinal axis of the leg. The terms lateral and medial should not be used since the morphological meanings of these are reversed on legs I and II as compared with III and IV. The decimal always represents the distance from the *base* of the segment to the structure in question, divided by the total length of the segment, exclusive of the claws in the case of the tarsi.

FIG. 2. *Anisochthodes papillifer*, n. sp. A, tarsus I and insert of famulus, female. B, tarsus II, female. C, tarsus III, male. D, tarsus IV, female.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tinguish the sex of the mite by the shape of the papillae at the posterior margin of the hysterosoma. Sex can, of course, be verified by the form of the internal genitalia, as well as by the presence of eggs in gravid females. Of 56 specimens in the writer's collection, 39 are females and 17 are males. This is probably not indicative of the sex ratio in the population as a whole, since it is quite possible that there was an unconscious selection for large specimens when these were sorted for mounting.

Type locality: Kawaiiki Ridge, Oahu, Hawaii. On bark and leaves of 'ohi'a lehua, *Metrosideros collina* (Forst.) Gray *polymorpha* (Gaud.) Rock, June, 1953, collected by F. H. Haramoto. The species was very abundant at this locality. Syntypes are deposited in the Bernice P. Bishop Museum, Honolulu, and the United States National Museum.

Remarks: This genus runs to the family Carabodidae Willmann, 1931, in modern keys. This position should be regarded as provisional in view of the fact that the Carabodidae as now constituted probably do not comprise a natural family and are in considerable need of revision.

## **Tetracondyla** Newell, 1956

One of the principal characteristics of this genus noted in the original description was the four-segmented palpi. Contrary to the description, however, this condition comes about through the fusion of the femur and patella, not through the fusion of the tibia and tarsus. The Oribatei are quite consistent in the chaetotaxy of the trochanter, femur, patella, and tibia of the palp, these segments typically having zero, two, one, and three setae, respectively (0–2–1–3). Overlooking one exceptional individual in the type series of *T. pallida* Newell, 1956, which had only two setae on the second segment of the palp, the first three segments of the palp normally have a setal formula of 0–3–3. The most logical interpretation of this is that the second segment represents the fused femur and the patella, and that the third segment is the tibia. This is further substantiated by the fact that in those Oribatei with five-segmented palpi the patellar seta is dorsal in position, the same position occupied by the most distal seta of the *second* segment of the palp of *T. pallida*. The diagnosis of the genus as well as its type species should be amended to read as follows: Palpi four-segmented, femur and patella fused. The fusion is complete in the type species, without even a trace of the suture.

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FIG. 3. *Anisochthodes papillifer*, n. sp. A, trochanter-tibia I, male. B, trochanter-tibia II. male (with insert of porose area). C, trochanter-tibia III, male. D, trochanter-tibia IV, male. E. papilla and duct of gland, female. F, papilla and duct of gland, male. G, patella III, solenidion, male. H, palpal tarsus, female. I, cuticular detail of dorsum, female. J, chelicera, posterior, male. K, chelicera, anterior, male.

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# Food Plants, Distribution, and Variation in Abundance of Conotelus mexicanus Murray, a Recently Discovered Immigrant Insect in Hawaii (Coleoptera: Nitidulidae)[1]

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*(Presented at the meeting of December 10, 1956)*

With minor exceptions, immigrant insects are the most important pests in Hawaii. This situation, although not unique to Hawaii, behooves us to investigate new immigrant insects to determine their status as pests. This paper presents some observations on a newly discovered nitidulid beetle, *Conotelus mexicanus* Murray, made during the course of investigations undertaken to determine whether or not this beetle was destructive or beneficial to the production of some of our local crops. Observations were made chiefly on Oahu during September to December of 1955 and during 1956 and to a lesser extent on Hawaii, Maui, and Kauai during October and November of 1956.

The presence in Hawaii of *C. mexicanus*, commonly known as the fruit bud beetle (Essig, 1929), was first reported by Bianchi in 1955 (Bianchi, 1955). According to Bianchi's report, this beetle was first observed by Mr. E. J. Ford at Waianae, Oahu, in March, 1955, and subsequently by hikers at Nanakuli in August of the same year. The beetle apparently entered Hawaii from either the southwestern part of the United States or from the areas south of it, for it is known that this beetle occurs in Arizona, southeastern California, Sonora (Morrill, 1916), Baja California, Mexico, British Honduras, Guatamala, Panama, and Perlas Island (Blackwelder, 1944).

The adults of *C. mexicanus*, which infest the flowers of various plants, may be distinguished readily from other flower infesting insects. They are slender insects, approximately 3 mm. long and 1 mm. wide. They are jet black and superficially resemble thrips; however, they are much larger than any of the flower-inhabiting thrips found in Hawaii. When infested flowers are examined, numerous adults may be seen moving about in a characteristic thrips-like fashion.

There is very little published information on the biology of *C. mexicanus*. The adults are known to feed on pollen, although at times they have been observed to feed on the base of the pistil (Morrill, 1916). They apparently

[1] Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Technical Paper No. 382.

feed also on nectar, for in Hawaii the adults frequently have been observed deep in the campanulate flowers of the morning glory where nectar is present. Although present in large numbers, there was no evidence of feeding either on the pistil, ovary, or the surrounding tissues of the corolla.

The economic importance of *C. mexicanus* is also inadequately known. Morrill (1916, 1917) reported that *C. mexicanus* is destructive to the flowers of roses, blackberries, peaches, and citrus. In citrus blossoms this beetle was observed to gnaw at the base of the pistil, thus damaging the flower. In other flowers, such as cotton and cucumber, the beetle appeared to cause no visible damage. It was also suggested that the beetle might be beneficial because of possible value in pollination.

The present study was begun shortly after the discovery of this beetle in Hawaii when a few adults of *C. mexicanus* were found on passion fruit flowers, *Passiflora edulis* f. *flavicarpa* Degener, in the eastern foothills of the Waianae range, a short distance from the area from which this insect was first reported by Bianchi. The main objectives were to determine whether or not *C. mexicanus* was a pollinator of the passion fruit flower and also to determine the status of this insect as a pest of some of our other crops. This study showed that *C. mexicanus* is of little or no importance as a pollinator of passion fruit flowers, and also that it is not a pest of any of our important crops. Yet it appeared desirable to present some of the results of the observations with the thought that they will contribute, in some measure, to our knowledge on this nitidulid beetle whose biology is so little known.

## Food Plants of *C. mexicanus*

The flowers of a large number of crop, ornamental, and wild plants were examined in order to determine the range of plant species infested by *C. mexicanus*. For each species of flower an infestation rating was made according to the following scale: few, when 0 to 4 beetles were present per flower; moderate, when 5 to 10 beetles were present; and abundant, when 10 or more were present. This procedure is, without doubt, subject to considerable error; however, a rough qualitative picture on the abundance of adults in various species of flowers may be obtained.

The results presented in table 1 indicate the range of plant species infested as well as the relative abundance of the adults of *C. mexicanus* in different flowers. The adults have been found in the flowers of 13 species, of which 3 are crop plants, 6 ornamental plants, and 4 wild plants. It is also evident from table 1 that the adults were most abundant in the flowers of species in the family Convolvulaceae. Although infested flowers in general were campanulate to funnel-shaped, not all flowers with this form were found to be infested.

Some of the flowers mentioned by Morrill (1916, 1917) as infested in Arizona were not found to be infested in Hawaii. According to Morrill the

flowers infested by *C. mexicanus* were blackberries, cucumbers, peaches, roses, cotton, oranges, and lemons. Although nearly all of these are grown in Hawaii on a limited scale, the observations made to date indicate that with the exception of cotton, the flowers of none of these plants were infested.

TABLE 1. The flowers of various plants in which *Conotelus mexicanus* was found during 1955.

| FAMILY | SPECIES | COMMON NAME | TYPE OF PLANT | RELATIVE ABUNDANCE[1] |
|---|---|---|---|---|
| Convolvulaceae... | *Ipomoea alba* L. | moon flower | wild | moderate |
| | *I. batatas* (L.) Poiret | sweet potato | crop | few |
| | *I. cairica* (L.) Sweet | koali'ai' | wild | abundant |
| | *I. congesta* R. Brown | koali'awahia | " | abundant |
| | *I. crassicaulis* (Bentham) Robin | bush morning glory | ornamental | abundant |
| | *I. tuberosa* L. | wood rose | " | few |
| | *Merremia aegyptia* (L.) Urban | hairy merremia | wild | few |
| Malvaceae..... | *Hibiscus rosa-sinensis* L. | hibiscus | ornamental | few |
| | *Gossypium* sp. | cotton (cultivated) | crop | few |
| Rubiaceae..... | *Gardenia jasminoides* Ellis | gardenia | ornamental | few |
| Leguminosae..... | *Canavalia microcarpa* (D. C.) Piper | maunaloa | " | few |
| Apocynaceae..... | *Stemmadenia galeottiana* (A. Rich.) Miers | lechose | " | few |
| Passifloraceae.... | *Passiflora edulis* f. *flavicarpa* Degener | passion fruit | crop | few |

[1] Ratings on abundance are: few, 0 to 4 beetles per flower; moderate, 5 to 9 per flower; and abundant, 10 or more per flower.

## DISTRIBUTION OF *C. mexicanus* IN HAWAII

According to Bianchi (Bianchi, 1955) the known areas in which *C. mexicanus* occurred were Nanakuli and Waianae, Oahu. In the present study, surveys were conducted to determine how widely *C. mexicanus* was distributed on Oahu and on some of the other islands. Two morning glory plants, *Ipomoea cairica* (L.) Sweet and *I. congesta* R. Brown, were used as indicator plants because the observations on the species of flowers infested (table 1) showed that *C. mexicanus* was most consistently associated with the flowers of these plants, and also because these species were widely distributed throughout the Hawaiian Islands. In this survey, morning glory flowers from various localities on Oahu, Kauai, Hawaii, and Maui were examined. Surveys were not made on Molokai and Lanai.

The results of this survey showed that *C. mexicanus* is considerably more widespread than originally reported. As shown in figure 1, this insect was present in all localities on Oahu where flower samples were taken. It was also

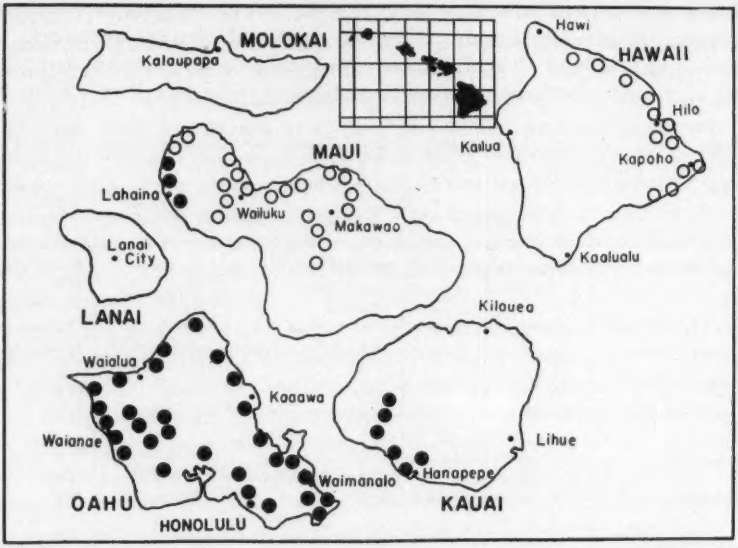


FIG. 1. The presently known distribution of *C. mexicanus* in Hawaii. Circles indicate localities where morning glory flowers were sampled; shaded circles indicate localities where *C. mexicanus* was present; open circles localities where it was not present. On Oahu *C. mexicanus* was present in all 40 localities sampled; however, all localities are not indicated.

present on Kauai where samples of morning glory flowers were examined on September 29 and 30, 1956. On that island *C. mexicanus* was found between Eleele and Kekaha and in the Puukapele areas. Surveys conducted on the island of Hawaii in the Puna, Hilo, and Hamakua areas during November 14 to 21, 1956, failed to show the presence of *C. mexicanus* in the areas covered by the survey; however, those conducted on Maui during November 22 to 23, 1956, showed that *C. mexicanus* was established in the Lahaina area but not in the Wailuku, Kahalui, Kula, Makawao, Haiku, and Paia areas.

The absence of *C. mexicanus* in certain areas of the Territory of Hawaii does not necessarily indicate that conditions in those areas are unfavorable for establishment. It means that the establishment of *C. mexicanus* in the Hawaiian Islands is a recent one and that the insect has not yet reached its ultimate distribution. It is, therefore, a matter of time before all available habitats will be occupied and *C. mexicanus* will be distributed more widely than is shown by this study.

## VARIATION IN ABUNDANCE OF *C. mexicanus*

During the month of May, 1955, efforts were made to determine the abundance of the adults in different localities on Oahu. An index of abun-

dance was obtained by counting the number of adult beetles in the flowers of *Ipomoea cairica* and *I. congesta*. In each locality a sample of 25 fully opened flowers was picked at random and the number of adults in each flower counted.

The data obtained from 11 localities, presented in table 2, show significant variation in the indices of abundance of *C. mexicanus* among different localities. The lowest index of 0.04 beetles per flower was obtained from samples taken in Kaaawa. Low indices were also obtained from samples taken from Hauula, Blow Hole, and Makapuu areas. The highest index was obtained from Lualualei. Other areas from which relatively high values were obtained were Mikilua, Waianae, and Halawa. Although it is not possible to draw definite conclusions, it appears from the data and field observations that *C. mexicanus* is better adapted to the dry leeward areas than to the more humid windward areas. This observation is not at all surprising in view of the occurrence of *C. mexicanus* in the arid southwestern part of the United States.

TABLE 2. The indices of abundance of the adults of *C. mexicanus* in morning glory flowers in different localities on Oahu. Data obtained during May, 1956.

| SAMPLE NO. | LOCALITY | TOTAL NO. OF BEETLES PER 25 FLOWERS | MEAN NO. OF BEETLES PER FLOWER | MEAN LOG NO. OF BEETLES PER FLOWER[1] |
|---|---|---|---|---|
| 1 | Blow Hole | 8 | 0.32 | 0.79 |
| 2 | Makapuu | 23 | 0.92 | 0.23 |
| 3 | Waimanalo A | 70 | 2.80 | 0.52 |
| 4 | " B | 47 | 1.88 | 0.40 |
| 5 | " C | 47 | 1.88 | 0.40 |
| 6 | Mikilua A | 70 | 2.80 | 0.41 |
| 7 | " B | 174 | 6.96 | 0.82 |
| 8 | " C | 44 | 1.76 | 0.35 |
| 9 | Lualualei A | 65 | 2.60 | 0.47 |
| 10 | " B | 398 | 15.92 | 1.10 |
| 11 | Waianae A | 52 | 2.18 | 0.40 |
| 12 | " B | 195 | 7.80 | 0.86 |
| 13 | Halawa | 229 | 9.16 | 0.93 |
| 14 | Kaaawa | 1 | 0.04 | 0.01 |
| 15 | Hauula A | 17 | 0.68 | 0.17 |
| 16 | " B | 13 | 0.52 | 0.12 |
| 17 | " C | 9 | 0.36 | 0.09 |
| 18 | Paumalu | 78 | 3.12 | 0.51 |
| 19 | Pupukea | 118 | 4.72 | 0.64 |
| Least significant difference at 5 per cent level | | | | 0.15 |
| Least significant difference at 1 per cent level | | | | 0.20 |

[1] In subjecting the data to an analysis of variance each variate was transformed according to the form $y = \log_{10}(x + 1)$, where $y$ is the value of the transformed variate and $x$ the original variate (Morris, 1955). The writer is indebted to Dr. Maurice Blackburn, Department of Zoology and Entomology, University of Hawaii, for directing his attention to this transformation.

The data presented also show significant variation in abundance of *C. mexicanus* among samples taken within the same areas. The indices obtained from Waimanalo and Hauula showed no significant variation; however, those obtained from Mikilua, Lualualei, and Waianae showed highly significant variations in certain samples. Aside from inherent differences in attractiveness of flowers of morning glory plants, such variations no doubt are manifestations of local differences in environmental conditions. One of the factors which was observed to influence abundance in localized areas was exposure to wind. Flowers from morning glory vines growing in sites exposed to the wind were observed to harbor fewer beetles than those in sheltered sites. Another factor which appeared to influence abundance in localized areas was the presence of ants. At Lualualei it was observed that in cotton flowers visited by large numbers of the crazy ant, *Paratrechina longicornis* (Latreille), *C. mexicanus* was present in smaller numbers than in those in which ants were not present.

## Summary

Field observations on *Conotelus mexicanus* Murray, a pollen-feeding nitidulid beetle recently found for the first time in Hawaii, were made during the latter part of 1955 and throughout 1956. At present this insect is of no importance in the pollination of the passion fruit, *Passiflora edulis* f. *flavicarpa*, and of no economic importance as a pest. The adults were found in the flowers of 13 species of which 3 are crop plants, 6 ornamental plants, and 4 wild plants. The adults were found most abundantly in the morning glory plants *Ipomea cairica* and *I. congesta*. Surveys conducted on Oahu, Kauai, Hawaii, and Maui showed that *C. mexicanus* is present on Oahu, Kauai, and Maui but was not found in the Puna, Hilo, and Hamakua Coast areas on Hawaii. On Oahu significant variations in the indices of abundance were found among different localities as well as within localities. The causes of these variations were not investigated, but the beetle was found to be most numerous in the dry leeward parts of Oahu and appears to be better adapted to such areas.

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# Recent Introductions for Biological Control in Hawaii—II

P. W. WEBER

BOARD OF AGRICULTURE AND FORESTRY
HONOLULU, HAWAII

(*Presented at the meeting of December 10, 1956*)

The following new introductions or releases on other islands of beneficial organisms have been made by the Board of Agriculture and Forestry since the last listing was published ("PROCEEDINGS," 16(1):162–164, 1956). Only the first release on each island is given. All liberations were made in 1956 except as noted.

**Harmonia arcuata** (F.) (INS. GUAM 1:158, 1942)

This coccinellid beetle was introduced from Canton Island to feed on aphids, scales, and aleurodids. It was released in several localities in Honolulu in March. The species was introduced from Guam in 1936 but is not known to be established.

**Apanteles agonoxenae** Fullaway (PROC. HAW. ENT. SOC. 11(1):48, 1941)
**Bracon** sp.

These two braconids were introduced from Fiji for the control of the coconut moth *Agonoxena argaula* Meyrick. The *Bracon* was released at Puna, Hawaii, in July and Kailua, Oahu, in August; the *Apanteles* was liberated at Kailua, Oahu, in October.

**Brachymeria agonoxenae** Fullaway (PROC. HAW. ENT. SOC. 14(1):63, 1950)

Introduced to the Territory from Samoa in 1948 by the Hawaiian Sugar Planters' Association for the control of *Agonoxena argaula*, this chalcid wasp was sent to Puna, Hawaii, in May, 1955.

**Gonaxis vulcani** (Thiele) (JOUR. CONCH. 20(9):270, 1936)
**Ptychotrema walikalense** Pilsbry (BULL. AMER. MUS. NAT. HIST. 40:203, 1919)

**Ptychotrema** sp.
**Gulella wahlbergi** (Krauss) (TRANS. R. SOC. S. AFRICA 12:120, 1925)
**Oleacina oleacea straminea** (Deshayes) (MAN. CONCH. 19:138, 1907)
**Oleacina** sp.

**Tefflus tenuicollis** (Fairmaire) (ANN. SOC. ENT. BELG. 38:314, 1894)
**Tefflus jamesoni** Bates (PROC. ZOOL. SOC. LONDON, p. 481, 1890)
**Scaphinotus striatopunctatus** (Chaudoir) (INSECTS WESTERN N.A., p. 375, 1926)
**Scaphinotus** sp.

Ten new predators of the giant African snail were introduced to Hawaii during 1956. Six of these are carnivorous snails, the others carabid beetles. Of the snails, *Gonaxis* and two small species of the genus *Ptychotrema* were introduced from the Belgian Congo; the former was released at Waiahole, Oahu, in October, and the *Ptychotrema* at Kaneohe, Oahu, in November. *Gulella wahlbergi* was introduced from South Africa; it was liberated at Kaneohe, Oahu, and Haiku, Maui, in December. The two *Oleacina* were introduced from Cuba and released at Kualoa, Oahu; *oleacea* in January and an unidentified species in July.

Two species of carabids of the genus *Tefflus* were also introduced from the Belgian Congo. They were liberated at Kaneohe, Oahu; *tenuicollis* in October and *jamesoni* in November. The two species of *Scaphinotus* were obtained from California; they were released at Kahana Bay, Oahu, in November.

**Syngamia haemorrhoidalis** Guenée (DELT. AND PYRAL., p. 201, 1854)

This pyralid moth was collected in Florida and Cuba and was introduced to Hawaii for the control of lantana. It was released on Round Top, Oahu, in April; Hookena, Hawaii, in May; Lawai Valley, Kauai, in June; and Haiku, Maui, and Puu Lua, Molokai, in September.

**Strepsicrates smithiana** (Walsingham) (TRANS. AMER. ENT. SOC. 74:176, 1948)

Also found in Florida, this olethreutid moth was introduced for the control of *Myrica faya* Aiton, a plant pest of pasture lands. It was released on Kukaiau Ranch, Hawaii, in July.

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In 1953 and 1954 some histerid beetles were introduced from Trinidad as general predators, principally on scarabaeid larvae. These have been identified as *Hololepta quadridentata* F. and *H. minuta* Erichson (ANN. SOC. ENT. FRANCE (3)1:212, 217, 1853). They have been referred to in these "PROCEEDINGS" as *Leionota* spp.

## New Insect Records for the Year 1956

Species marked with an asterisk were reported from the Hawaiian Islands for the first time in 1956 on the dates recorded in the text. Those not so marked were observed here earlier, but have only now been identified.

### CHANCE IMMIGRANTS


PAGE

*Habrolepis rouxi Compere (Hymenoptera: Encyrtidae) ..... 183
*Brachycara sp. (Diptera: Stratiomyiidae) ..... 184
*Oosternum spp. (Coleoptera: Hydrophilidae) ..... 185
*Pectinophora scutigera (Holdaway) (Lepidoptera: Gelechiidae) .. 185
*Apoanagyrus californicus Compere (Hymenoptera: Encyrtidae) .. 186
*Anthribid beetle (Coleoptera: Anthribidae) ..... 186
*Phytobia maculosa (Malloch) (Diptera: Agromyzidae) ..... 188
*Mycophila fungicola Felt (Diptera: Cecidomyiidae) ..... 189
*Arthrocnodax walkeriana Felt (Diptera: Cecidomyiidae) ..... 189
*Lestremia cinerea Macquart (Diptera: Cecidomyiidae) ..... 189
*Lestremia leucophaea (Meigen) (Diptera: Cecidomyiidae) ..... 189
*Lepidosaphes tuberculata Malenotti (Homoptera: Diaspididae) .. 190
*Calendra cariosa (Olivier) (Coleoptera: Curculionidae) ..... 190
*Heliothis virescens (F.) (Lepidoptera: Phalaenidae) ..... 190
Zetha simonyi (Krauss) (Orthoptera: Blattidae) ..... 190
*Macrobiotus hufelandii Schwartz (Tardigrada: Macrobiotidae) ... 191
*Milnesium tardigradum Doyere (Tardigrada: Milnesiidae) ..... 191
*Hypsibius canadensis Murray (Tardigrada: Macrobiotidae) ..... 191
*Aphycus flavus Howard (Hymenoptera: Encyrtidae) ..... 192
*Ptinid beetle (Coleoptera: Ptinidae) ..... 195
*Eotetranychus sexmaculatus (Riley) (Acarina: Tetranychidae) .... 196
*Metatetranychus citri (McGregor) (Acarina: Tetranychidae) ..... 196
*Tuckerella ornata (Tucker) (Acarina: Tuckerellidae) ..... 196
*Brevipalpus australis (Tucker) (Acarina: Phytoptipalpidae) ..... 196
*Meliana sp. (Lepidoptera: Phalaenidae) ..... 197
*Radfordia affinis (Poppe) (Acarina: Myobiidae) ..... 197
*Myocoptes musculinus (Koch) (Acarina: Listrophoridae) ..... 197


### BENEFICIAL SPECIES PURPOSELY INTRODUCED


*Ootetrastichus megameli Fullaway (Hymenoptera: Eulophidae) .. 181
*Syngamia haemorrhoidalis Guenée (Lepidoptera: Pyralidae) ..... 192

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# CONTENTS OF VOL. XVI, NO: 2, MAY, 1957

(Actual date of publication, May 13, 1957)


| Minutes, Notes, and Exhibitions | PAGE |
|---|---|
| January meeting | 181 |
| February meeting | 182 |
| March meeting | 183 |
| April meeting | 184 |
| May meeting | 185 |
| June meeting | 187 |
| July meeting | 188 |
| August meeting | 189 |
| September meeting | 191 |
| October meeting | 192 |
| November meeting | 194 |
| December meeting | 196 |
| New Insect Records for 1956 | 315 |
| Officers and Membership for 1956 | 316 |

PAPERS

BEARDSLEY, J. W.:
The Genus Pedronia Green in Hawaii, with Descriptions of New Species (Homoptera: Pseudococcidae) ..... 218
Trionymus rostellum Lobdell in Hawaii (Homoptera: Pseudococcidae) ..... 209

BOYLE, W. W.:
On the Mode of Dissemination of the Two-spotted Spider Mite, Tetranychus telarius (L.) (Acarina: Tetranychidae) ..... 261

COLYER, C. N.:
A New Species of Conicera (Diptera: Phoridae) from Hawaii, with Observations on the Genera Parafannia Bohart and Gymnoptera Lioy ..... 232

FERRIS, G. F.:
Two Species of Diaspididae New to the Hawaiian Fauna (Homoptera: Coccoidea) . 212

FULLAWAY, D. T.:
Checklist of the Hymenoptera of Fiji ..... 269

GRESSITT, J. L.:
Chrysomelidae of Samoa (Coleoptera) ..... 241

HARDY, D. E.:
Austromyia neglecta Hardy, a New Synonym of Neotoxura discoidalis (Bezzi) (Diptera: Pyrgotidae), with a Discussion of Some Family Relationships ..... 259

KULZER, Hans:
Eine neue Tenebrioniden-Art von Oahu (Coleoptera) ..... 216

NAMBA, RYOJI:
Cryptophlebia illepida (Butler) (Lepidoptera: Eucosmidae) and Other Insect Pests of the Macadamia Nut in Hawaii ..... 284

NEWELL, I. M.:
A New Genus and Species of Oribatei (Acari) Exhibiting External Sexual Dimorphism ..... 298

NISHIDA, TOSHIYUKI:
Food Plants, Distribution, and Variation in Abundance of Conotelus mexicanus Murray, a Recently Discovered Immigrant Insect in Hawaii (Coleoptera: Nitidulidae) ..... 307

OBITUARY:
Philip Wadsworth Weber ..... 208

PETERSON, G. D., JR.:
Recent Additions to the List of Insects which Attack Crops and Other Important Plants in Guam ..... 203

An Annotated Checklist of Parasites and Predators Introduced into Guam during the Years 1950–1955 ..... 199

USINGER, R. L. and J. L. HERRING:
Notes on Marine Water Striders of the Hawaiian Islands (Hemiptera: Gerridae) .. 281

WEBER, P. W.:
Recent Introductions for Biological Control in Hawaii—II ..... 313

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